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Pentium Pro/200s

45 Versions of the New Standard
For Corporate Desktops

NETWORK EDITION

CD-ROM Servers: Networking
That Enhances Security and Saves Money

MAGAZINE

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NT 4.0

AND HOW DOES OS/2 STACK UP?

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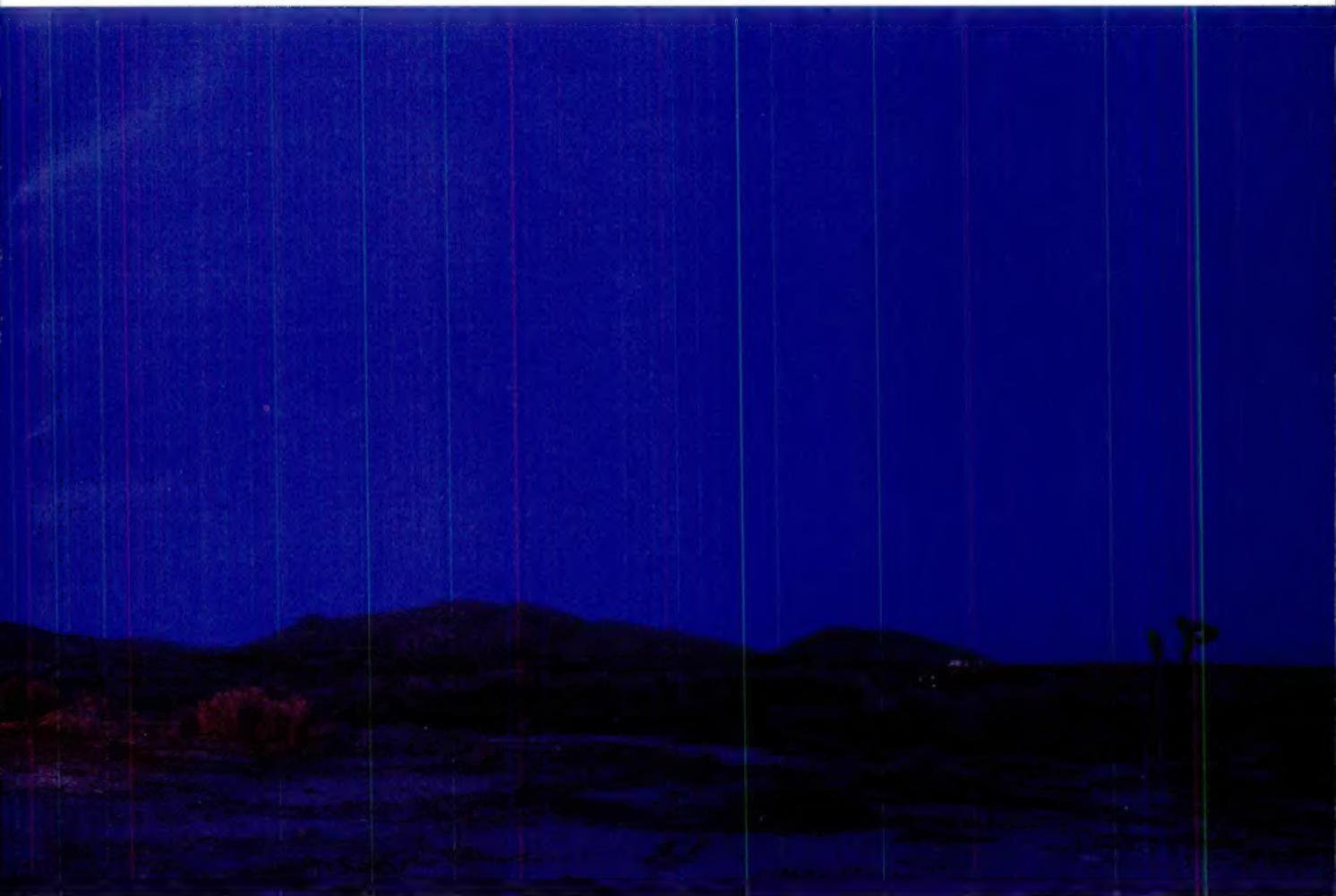
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Inside

The CD-ROM market has been full of surprises this last year. Despite the world's headlong rush to the Internet, there are suddenly more CD-ROM titles than ever before, and CD-ROM sales are way up. But, as in the past, the quality of the titles continues to range widely between top-notch fare and out-and-out junk.

How do you separate the wheat from the chaff? For the third straight year, this job fell to senior associate editor Lance

to come up with our list of the top 100 CD-ROMs.

The first step was to narrow down the list to around 800 titles, a number that included the best sellers as well as those CD-ROMs suggested by our readers and by people in the industry. Our next review thinned the field to slightly more than 500 CD-ROMs, which then received formal testing in our Labs. In our testing, we examined each title for its multimedia prowess, quality of user interface, resource requirements, and, of course, quality of content—the most important factor of all.

When our team members were done, they carefully picked the top 100 CDs across several categories. "This year, we were pleasantly surprised that the bulk of the CD-ROMs we examined delivered on their promises," said Lance, reflecting on the compatibility problems and just plain lack of quality from which many of the previous years' nonwinners suffered. "We were more entertained, informed, and engaged than ever before."

You'll find the complete story in this issue's PC Magazine At Home section. Prepare to be surprised at the breadth and depth of today's vibrant CD-ROM market.—*Michael J. Miller*



Our New York-based team of CD-ROM reviewers visits "Silicon Alley," the birthplace of many of the top 100 CDs.

Ulanoff and a team of more than 30 PC Magazine writers, editors, and Labs staff. Together, they sifted through the thousands of CD titles released in the past year

PHOTOGRAPH BY THOM O'CONNOR

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CIRCLE 292 ON READER SERVICE CARD

UP FRONT

Inside

CD-ROMs come on strong.....4

Letters

War on the Web.....19

Trends

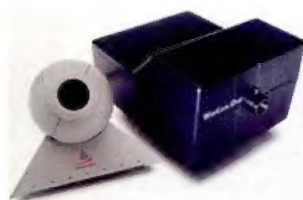
- Intel's media-rich Net31
- Micropanel breakthroughs34
- Searching for meaning on the Web.....36
- Is Enhanced CD ready to rock?37

Pipeline

Planning a RAM upgrade? Wait no longer!.....37

First Looks

- Pentium/150 notebooks39
- Windows 95 OCR programs43
- PC support online.....52
- Connectix Color QuickCam and WinCam60



Bringing digital photography to your desktop (page 60).

Second Looks

Update your PC at the touch of a finger73

COLUMNISTS

Michael J. Miller

From the Editor-in-Chief ...29

Bill Machrone

A PDA for Musicians85

John C. Dvorak

Software Dumping.....87
Inside Track.....89

Jim Seymour

The Removable-Storage Mess.....93

Bill Howard

House for Sale95

COVER STORY

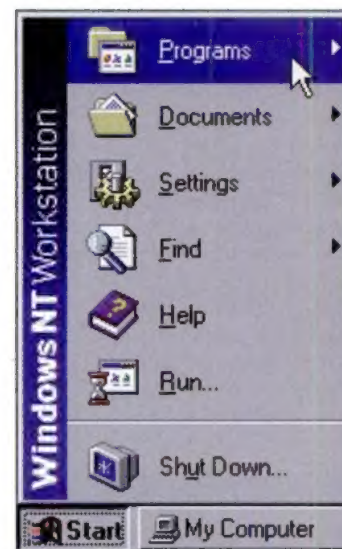
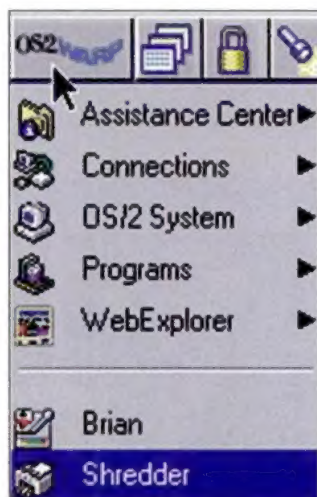
Life Beyond
Windows 95

And

NT 4.0 OS/2 4.0 Head for the Desktop

BY MICHAEL J. MILLER Microsoft and IBM are both about to release new desktop versions of their long-standing operating systems, Windows NT 4.0 and OS/2 Warp 4.0 (publicly code-named Merlin). We preview their architectures, new features, updated interfaces, and network ser-

vices. All of this serves to help us examine the crucial issues pertaining to your decision to purchase one of these OSs: performance versus stability, compatibility versus compactness, and ease of use versus robustness. With these factors in mind, you can start deciding whether one of these OSs belongs on *your* desktop101



Comparing and Contrasting Today's OSs.....	102
Sharing the Wealth: DCOM and DSOM.....	104
<u>Choose Your Processor.....</u>	<u>109</u>
Will Upgrades Affect Performance and Stability?.....	110
Microsoft Windows NT 4.0.....	115

Finally, a Universal UI for Windows (Almost).....	118
Windows NT 4.0: Rebuilt for Speed.....	120
Now Windows NT Has Apps of Its Own.....	132
<u>Are You Being Served?.....</u>	<u>134</u>
<u>OS/2 Warp 4.0.....</u>	<u>137</u>

OS/2 4.0: New Face, Same Pipes.....	138
Taking a Look at the Next OS/2.....	139
Why Can't OS/2 and Windows Get Along?.....	142
Warping Applications.....	143
Are You Being Served?.....	145

FEATURES

Pentium Pro PCs: Power to the People



BY CAROL VENEZIA Surprisingly affordable at an average price of \$3,500, 200-MHz Pentium Pro PCs are ready for the corporate market—and the mating of a 32-bit environment and a Pentium Pro CPU ensures that your investment can grow with you. This level of affordability does not come at the expense of performance: Systems here have plenty of power and

feature top components such as blazingly fast hard disks and the latest Intel chip sets. Many vendors also provide extras for corporate buyers, packing their PCs with network and system management tools. PC Magazine Labs tests 45 Pentium Pro business desktops, each equipped with Windows NT Workstation 3.51 using 32-bit performance measures to find which are deserving of a spot on your corporate LAN146



Aberdeen Inc.	158
Acer America Corp.	158
ACMA Computers Inc.	160
ACW (All Computer Warehouse)	160
Advanced Logic Research Inc.	160
American MultiSystems Inc.	164
AST Computer	164
Brysis Data Inc.	172
Caliber Computer Corp.	172
Comtrade Electronic Inc.	174
Cybermax Computer Inc.	174
Dell Computer Corp.	176

Diamond Technologies Inc.	176
DirectWave Inc.	177
DTK Computer Inc.	177
EPS Technologies Inc.	177
Everex Systems Inc.	178
First Computer Systems Inc.	178
Gateway 2000 Inc.	183
Hertz Computer Corp.	183
Hewitt Rand Corp.	183
Hewlett-Packard Co.	184
HiQuality Computer Systems	185
Maximus Computers Inc.	188

Mega Computer Systems	189
Micro Express	192
Micron Electronics Inc.	193
Mitsuba Corp.	194
Multiwave Technology Inc.	194
NEC Technologies Inc.	194
Polywell Computers Inc.	197
ProGen Systems	198
Quantex Microsystems	198
Reason Technology Inc.	198
Robotech Inc.	199
SAG Electronics	199

Sys Technology Inc.	202
Tagram Systems Corp.	202
Total Peripherals Inc.	202
Unisys PC Division	204
Unitek Technology Inc.	204
Vektron	204
Xi Computer Corp.	205
Zenon Technology Inc.	205
Editors' Choice	149
Price/Performance Index	157
Summary of Features	184
MMX and AGP	196

AT HOME

The Top 100 CD-ROMs

Every year, hundreds of new informative and entertaining CD-ROMs flood the home consumer market, targeting audiences that range from game lovers and education seekers to reference users and hobbyists. For our third annual roundup, we tested 500 CD-ROMs on their content, interface, setup process, use of multimedia, and resource requirements to present you with the very best 100.321

Educational Fun	322	Home Office	335
Games &		Reference	336
Entertainment	326	Pet Peeves and	
Home & Hobbies	332	CD-ROM Pleasures	323



PC TECH

Power Programming*

BY RAY DUNCAN

How the Common Gateway Interface works207

Internet Tools

BY NEIL RANDALL

How DNS servers work217

Utilities*

BY GREGORY A. WOLKING

BootOpt provides a graphical user interface for Windows 95 startup options222

PC SOLUTIONS

User-to-User

BY NEIL J. RUBENKING

Split large files over several floppy disks with PKZIP; extracting files from the Windows 95 CD-ROM; environment variables in Config.sys; giving Windows 95 a Windows 3.1 look231

ASK OUR ADVISORS

Hardware

The lowdown on boot-drive order; performance gains you'll see when you add more memory to your system; the difference between resident and nonresident fonts and how printers handle them234

Operating Environments

Copy protection in Windows 95; a floppy disk problem with the Windows 3.1 File Manager; making more room on the OS/2 Warp desktop.....242

Word Processing

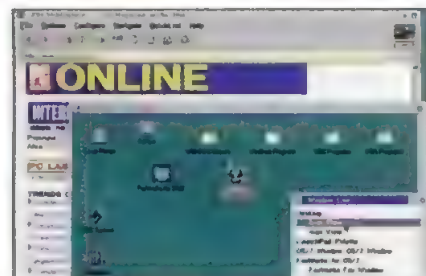
Globally changing bullets in Ami Pro 3.1.....248

Spreadsheets

How shading a range of cells in Excel affects gridlines.....254

Databases

Creating forms without menu bars in Microsoft Access.....254



Find out how to keep your OS/2 Warp desktop icons at the ready (page 248).

NETWORK EDITION

Follows page 96

Cover Story

Network CD-ROM Servers.....NE1

►Logiccraft XF 5500 LanCD

Server.....NE6

►Meridian Data CD NET 807

CD-ROM Network Server.....NE8

►Microtest DiscPort Tower.....NE8

►Plexor PlexServer NT.....NE11

First Looks

►AltaVista Mail.....NE19

►Imail.....NE20

Multiple Access

BY FRANK J. DERFLER, JR.

We Know Who You Are.....NE24

A message to the troops about the new dress code (page 350).

ALSO IN THIS ISSUE

PC Direct231

PC Magazine Marketplace.....282

Premier282

Classified303

BusinessCard318

Reader Service Card301

Advertisers' Index: Companies.....345

[Advertisers' Index: Products.....346](#)

Coming Up.....348

Editorial Product Index.....349



PC MAGAZINE BEYOND PRINT



WHAT'S NEW ONLINE

Do you spend endless hours on the Web looking for software, hoping that the next 45-minute download will actually ease your computing routine? From now on, just go to PC Magazine Online's Downloads area, where you can make an informed decision on whether to download. Downloads has PC Magazine's utilities, PC Tech archives, benchmark test software, and access to the entire ZD Net software library. Or visit InternetUser and we'll point you towards the latest Internet-related software.

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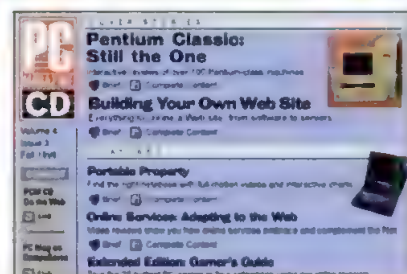
Gamer's Guide

Video reviews of the 25 hottest PC games in four categories.

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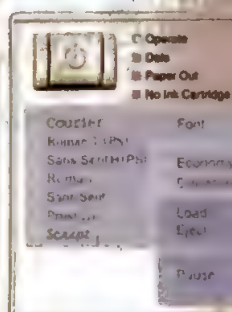
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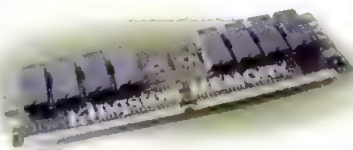
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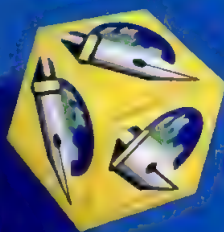


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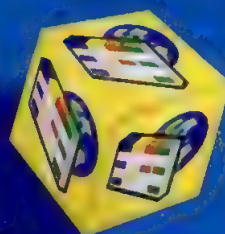
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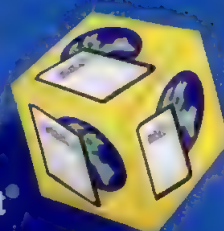
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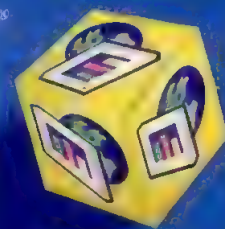
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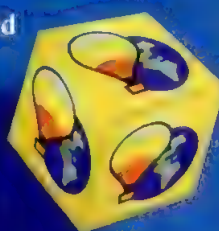
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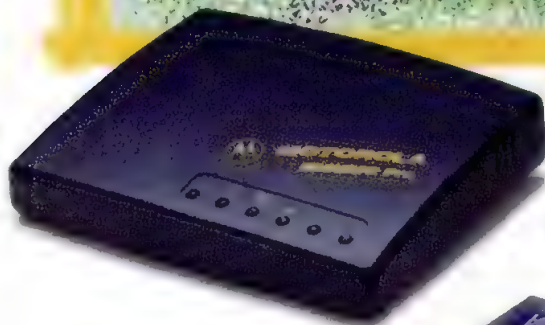
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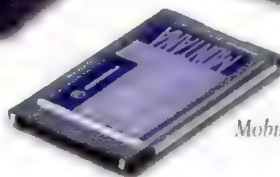
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Letters

WAR ON THE WEB

I suspect that John C. Dvorak is correct in predicting that Microsoft will ultimately squash Netscape in the browser war ("Why Microsoft Will Beat Netscape," May 28, 1996), despite Netscape Navigator's currently dominant market share. I believe that in choosing among similar products, many users base their decisions less on intrinsic superiority than on the perception of inevitable market domination. Those who guess incorrectly end up with Betamax VCRs or VL-Bus computer motherboards. I wonder to what extent predictions such as Dvorak's help create the very outcomes they foresee—especially when they come from such heavyweights.

RON POIRIER
via the Internet

The real struggle is between Netscape's and Microsoft's enhancements to HTML. Navigator has been the standard up to now, and enhanced Web sites are viable simply because Netscape has 80 percent of the browser market. Will Microsoft ever gain control? Someone must win the HTML war before there can be an answer. The National Center for Supercomputing Applications (NCSA) lost to Netscape in the HTML battle, and now Microsoft is poised to steal Netscape's mantle.

DARIN BERNARD
via the Internet

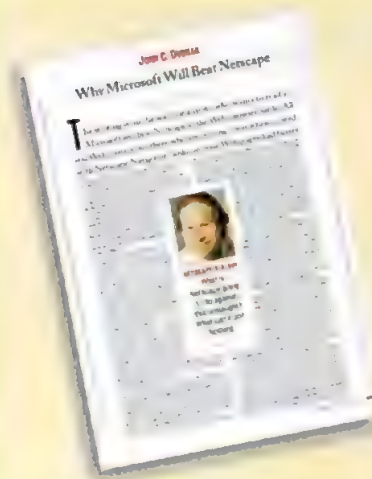
Netscape Navigator 2.02 and Netscape Atlas, beta 3.04, are two of the finest products I have ever used. By contrast, Microsoft neglected to add newsgroup reading to Internet Explorer and requires its users to use Exchange for e-mail. In my opinion, Microsoft's browser efforts are simply reactions to Netscape's innovations. Nobody ever won a race by following the leader.

RANDY COOK
via the Internet

I couldn't agree more with Dvorak. Where would these upstart companies be if Gates and Co. didn't enable over 100 million computers to operate on a common software platform? If not for Microsoft, the Internet would still be the domain of nerds, techies, and government research labs.

KEN LAHODA
via the Internet

One aspect of the browser battle that no one seems to mention is Unix. Netscape Navigator runs on it; Microsoft Explorer doesn't. There are millions of Unix machines on the Internet, most of them probably connected at higher speeds than the Windows machines. If



To what extent do predictions such as Dvorak's help create the very outcomes they foresee?

Microsoft really wants to win the battle, it'll have to come up with a Unix version.

RANDY SCHRICKEL
Columbia, Maryland

OBJECTION NOTED

The May 28, 1996, Inside column states that *PC Magazine* is now reporting on prerelease Internet-access software. I object strongly. I'm tired of products that do not work as advertised, and of an industry that feels it can foist this sort of half-baked thing on the consumer in the name of rapid progress. Post something in your online version so the masochists who want this stuff can find it there, but do not give buggy, untried beta-ware—free or otherwise—the dignity it does not deserve by reporting on it in the printed version.

FRANK BILLINGTON
via PC MagNet

NEEDLE IN A HAYSTACK

The PC Tech article "The Windows 95 Exchange Inbox" (May 28, 1996) was very informative about some of the basic but undocumented aspects of Exchange Inbox. But I would like to see an article that details how people can use the Inbox to their advantage. There are thousands of programs out there, and one of the tougher tasks today is to understand which can be beneficial and which will only confuse and waste time.

JAMES H. FEDERLEIN
via PC MagNet

There is a much easier way to open files with your application of choice using Windows 95 Explorer than the laborious method de-

scribed in "A New Way to Open Windows 95 Files." Add any word processor, editor, database, or spreadsheet program to the "send to" folder located under Explorer. Then, when you right-click on the name of a data file, you can open it with any of those applications. I find it much simpler than using MultiLaunch.

DOUG HARPER
via PC MagNet

THE INNOVATION EQUATION

Concerning Jim Seymour's May 28, 1996, column, "The Risks (and Rewards?) of Innovation": Compaq's proprietary innards have caused me no end of aggravation. Why, for example, does the company insist on using a different part number for exactly the same Conner hard disk that every other PC maker uses? Compaq's proprietary leanings make upgrades more costly as well. Whether it's IBM's Micro Channel or a Compaq memory board, both are headed for the scrap heap. By contrast, our standard clones are getting new motherboards, drives, video boards, and memory to bring them up to speed.

W. D. BASELEY
via the Internet

One way hardware manufacturers can innovate is to offer a wider choice of physical configurations. For example, I'd like to see a choice of colors; some new keyboard and monitor configurations; a place for the disk, CD-ROM, and tape drives in a small, free-standing chassis; and another place for the CPU box so we don't have to listen to fans and hard disks humming away. A world of opportunity is open to the manufacturer who understands that this equipment is part of our office/home decor.

GARY BLACKMAN
Escondido, California

THE TIME IS NOW

Michael J. Miller's May 28, 1996, column, "Remember Groupware?" focused on the concern that groupware might not justify the claims made when it was the latest buzzword. (Miller proceeded to chant a more recent buzzword, *client/server messaging*, and followed it up with a discussion of the latest craze: the intranet.) I agree that we will always hear promises that won't be met. The real issue is not what technology might be able to do for me tomorrow but what it will do for me today. I wish Miller would stop worrying about what his colleagues and competitors are buzzing about and instead focus on what works now.

IAN SHERWOOD
via the Internet

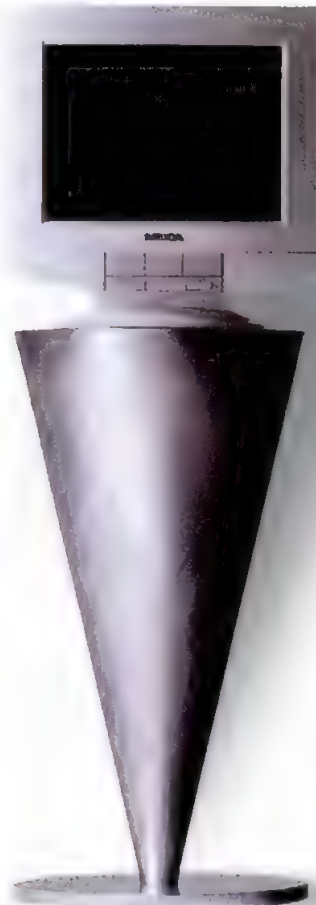
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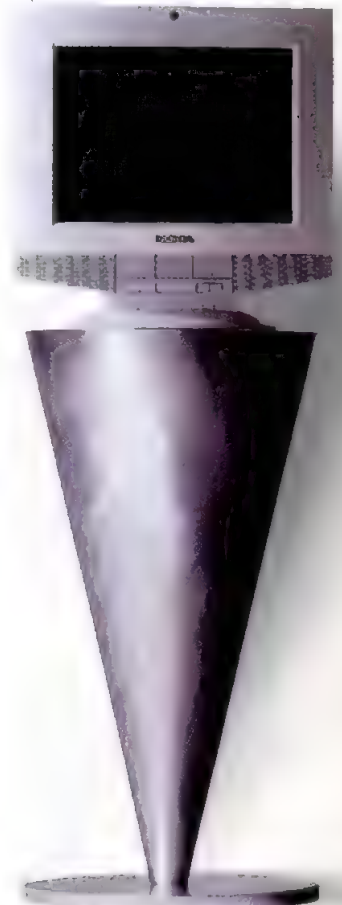
As 17" becomes the standard for your multiple applications, and applications become more media-intensive, don't just settle for a bigger system. Acquire a better one. A media-ready Nokia 447X.

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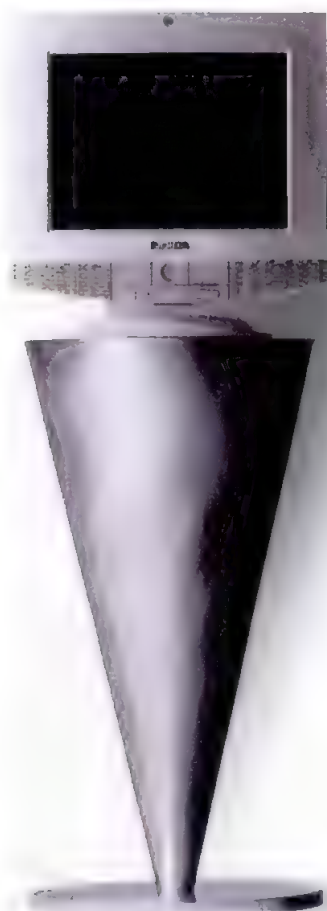


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and communications applications require, without a nest of wires and speakers fighting for the precious real estate around your computer.

The audio capabilities of the media-ready series extend to the built-in microphone set in the top of the bezel (at ideal voice height). This feature completes the requisites for computer telephony. The 447Xavc model even houses the world's first inboard color video camera for video-capture and conferencing. Truly, the media-ready series enables the complete convergence of computing and communications.



447Xavc—Adds to X series features with built-in color video camera

Of course, each of these systems comes with full digital controls and on-screen menu-driven adjustments (which Nokia also pioneered). Yet their pricing is remarkably competitive. All of which makes the new 447X series a necessity for anyone making full use of their computer. After all, the best way to meet the standards is to work with the people who set them. Visit us at www.nokia.intltech.com or call 1.800.BY.NOKIA, Dept. N412.

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Letters

COMMUNICATIONS BREAKDOWN

So-called translators (such as Web Translator), reviewed in First Looks, May 28, 1996, might be useful teaching tools, but they will make a fool of anyone who relies on them to translate foreign languages for use in written documents. One could forgive their quirks if they were sold as helpers rather than translators; languages are exceedingly complex, eccentric, and sometimes irrational to outsiders. But I can't think of any class of software that is so universally and hilariously incapable of doing what the packaging claims it does.

JOHN RICE
Mexico City, Mexico

THE FINE PRINT

I read with interest your glowing review of the HP DeskJet 820Cse in your At Home story, "An Ink Jet In Every Pot" (May 28, 1996). So I bought one, only to find that the printer doesn't have a driver for Windows NT and probably never will, according to an HP representative. You should have alerted your readers to this limitation.

ELDON ZIEGLER
via the Internet

After reading your review of the HP DeskJet 682C color ink jet printer, I tried one at the store and was impressed with the print quality as well as the speed. But you say in the review that it is "the first ink jet printer that can print on fanfold paper." Actually, the HP ThinkJet monochrome printer printed on fanfold paper over a decade ago, as did the HP PaintJet color printer. In fact, the HP

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We regret that we cannot answer letters individually. To send submissions for PC Solutions, please see the sidebar "How to Contact Us" on the second page of that column.



CORRECTIONS AND AMPLIFICATIONS

The correct phone number for Brother International's HL-700 series of laser printers (New & Improved, August, 1996) is 714-859-9700; the fax number is 714-859-2272.

The correct phone number for Financials Online, also mentioned in the August issue (in the Briefs section of New & Improved) is 301-468-6600.

DeskJet 682C is merely the first of the new generation of high-quality, low-cost color ink jet printers to print on fanfold paper.

DENNIS J. HERRING
Columbus, Ohio

GIVING CREDIT WHERE IT'S OVERDUE

Thanks for including Alpha Five in your roundup "Kinder, Gentler Databases" (May 28, 1996). Alpha's programs have a lot of power, and its upgrades cost less than most. Too many computer magazines ignore Alpha Software's Windows and DOS products.

ROBERT JACKSON
Kaneohe, Hawaii

PASSION BREEDS PASSION

I totally agree with Jake Kirchner's advice on passion, "Don't waste it on a corporation, and don't waste it on a machine," in his follow-up Pipeline column "A Passion for Personal Computing, Mac-Style" (June 11, 1996). Rivalries over operating systems seem to have taken on a frenzy akin to that of a religious war. If you're really satisfied with your choices, you should feel no need to attack others who make different choices.

RANDELL GRENIER
Waltham, Massachusetts

If some Macintosh users are passionate about their machines, it's because they are passionate about what their machines enable them to do. Elegant design has everything to do with how you can use a machine, and the Macintosh's elegance is the key to understanding why there is no Windows or Intel counterpart to the phrase *Mac enthusiast*. Moreover, the notion that someone can waste passion, or save it to spend on select activities, contradicts the very definition of passion.

JON ERICKSON
via the Internet

The Mac is an idea. I write a Mac program not for a specific machine but for an environment, a place that my program can call home. And what a wonderfully rich home, filled with treasures such as multiple audio/visual inputs that you can query down to the last detail. I have no passion for Apple, just for what it's created. For that it has my support.

DAVID FINDLEY
via the Internet

Kirchner's words ring true in one sense, but consider the photographer who reveres his Hasselblad or Nikon, or the guitarist who

reveres his particular Gibson Les Paul or Fender Stratocaster above all others. Such tools are, in one respect, just machines. But to the person who uses them to create according to his or her personal visions, they become much more. Passion is not wasted on a machine; it defines it.

JEFFRYE GLENN TVERAAS
via the Internet

I still find that most PC users do not take the Macintosh seriously and view it as a vamped-up Amiga for games. This is a stereotype left over from the pre-Macintosh days that is hard to break, despite the fact that the Macintosh platform offers the same functionality as others.

KARL SCHMIDT
Pembroke, New Hampshire

Kirchner is correct in noting Apple's arrogance when dealing with the computer industry. It has made some serious mistakes, yet I believe the company's new CEO, Gil Amelio, will correct them. The company has made a great effort to include Internet capabilities in its software. I love Open Transport, Open Doc is becoming the object-oriented standard, and the QuickTime logo is everywhere. As for the letters of fury Kirchner has received: The media largely ignored Apple a few months ago, but suddenly it can't get enough of Apple when it comes to discussing its demise. Perhaps the Macintosh community sees the need for some balance and a little more objectivity.

DAVE MEZYNSKI
via the Internet

A LONG WAY TO GO

I've been in the image acquisition business for a number of years now, and I agree with Bill Machrone ("Breaking the Law," June 11, 1996) that it's great fun to display pictures on a television screen. But the technology that he used to perform this magic is too expensive and produces poor quality when compared with Kodak's PhotoCD. A system that has been around for a number of years, it combines the best of today's conventional photographic and digital imaging technology. The digital camera has a long way to go to match the quality of a PhotoCD digital image, the versatility of my 15-year-old Nikon camera, and the display capabilities of my Panasonic 3DO player.

ROB ALBERTA
via the Internet

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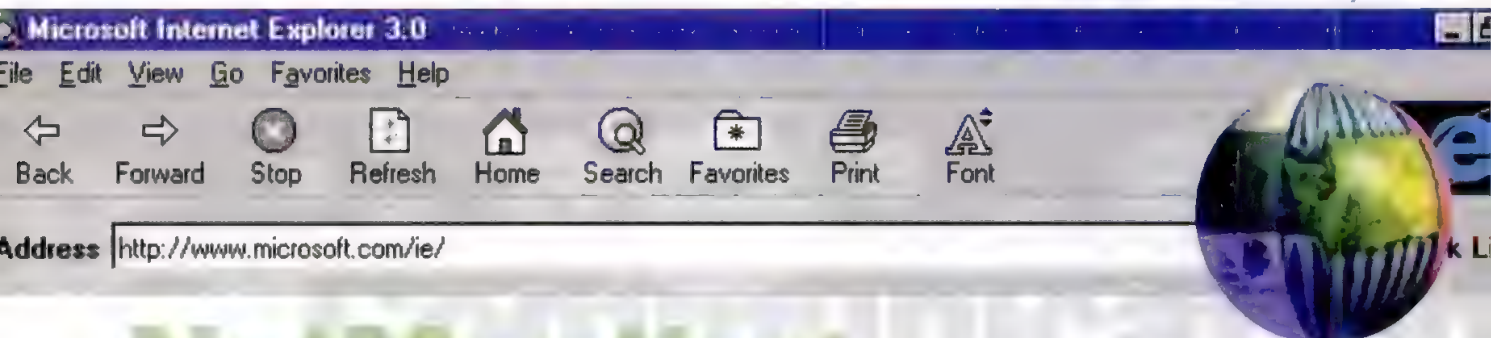
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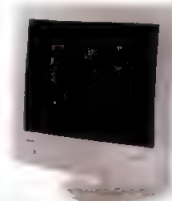
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Unmet Promises

In my office, I have one desktop PC running Windows NT Workstation 4.0, another system running OS/2 Warp 4.0 (a.k.a. Merlin), and a laptop running Windows 95. Considering that a year ago nearly everyone was running DOS or Windows 3.x (in

fact, many of you probably still are—at least in the office), the progress has been pretty amazing. All of these operating systems have new, easier-to-use interfaces. All are considerably more robust. And all—with the possible exception of Win NT—fit comfortably on Pentium-class PCs with 16MB of RAM, today's middle-of-the-road box. Generally, I'm pleased with the progress. But a little voice in the back of my head keeps whispering, "This isn't quite right."

I'm not talking about the little idiosyncrasies that make all computer users cringe. And I'm not asking for a completely bulletproof operating system (although Win NT and OS/2 are getting pretty close). As long as users are allowed to pick drivers and load applications that change system-level components, there will always be a chance that they choose something less than perfect. No, I'm talking about the fact that none of these operating systems is what the vendors were promising only a couple of years ago.

Windows NT 4.0 is getting a lot of attention, and I think it's a very attractive option for someone who wants a robust operating system that works with the newer Win32 applications and has the Win 95 interface. But it's not Cairo—the next-generation, completely distributed operating system Microsoft has been promising for years. Cairo was supposed to be out by '94 or '95; now we'll be lucky to see it in early '98. Of course, many of the features that were supposed to be in that release originally are out now, such as a user-friendly interface and distributed COM. But other things, like a distributed file system, just aren't ready yet.

Of course, Microsoft is hardly alone in this regard. Consider IBM. Merlin, version 4.0 of OS/2 Warp, is easier to learn than its predecessor, thanks to a gentler user interface. And the new voice recognition features demo well. Still, Merlin is a long way from the "Workplace OS" that IBM was talking about just a few years back—a microkernel-based, completely distributed OS capable of working on multiple architectures and running multiple "personalities," including OS/2, Windows, and Macintosh. One version was completed for the PowerPC but shelved, and IBM doesn't



FALLING SHORT
None of these operating systems is what the vendors were promising only a few years ago.

talk about the Workplace OS anymore.

The same is true for Apple. I've temporarily moved the Macintosh system out of my office, but we have plenty of them in our art department, and I can still fondly remember how the Mac OS shook up the PC universe. A decade ago, Apple was talking about Pink, its multitasking, multithreaded answer to OS/2. Well, Pink got into a joint venture with IBM, which evolved into Taligent. Parts of it were completed a year or so ago, but nobody noticed. Meanwhile, Macintosh is now on System 7.5.3, update 2. (No, I'm not making this up.) The next-generation Macintosh operating system, known as Copland, was due out by now but has been delayed; and now Apple says it will roll out periodic incremental releases rather than wait until it's all finished—which means it will be even longer before Apple has a multitasking, multithreaded operating system.

Does all this matter? I think it does, because operating systems still define the parameters in which programmers create their software, and this, in turn, affects the look, feel, stability, and capabilities of the applications we use every day. Now, it may well be true that we're moving to a

more distributed, cross-platform environment based on little components or applets that run on multiple machines. But even in this scenario, we end up with a series of new specifications that together act like an operating system. Anyway, all this is still more theory than practice—performance and, in some cases, features are still largely determined by OS-specific attributes and compilers. To get into the game, you still have to buy a machine with Windows 3.x, 95, or NT; OS/2; the Mac OS; or some flavor of Unix.

For now, I'm left recommending Windows 95 for most home users, people who want to play games, or those who use portable computers. Windows NT is best suited for corporate desktops, where stability and Win32 capability are critical, and OS/2 is a good choice for shops with OS/2 applications. Macintosh is still the best choice for a graphics department. In general, it's a pretty good set of choices—far better than what we had a few years back. But it could have been a lot better. □



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Trends

TRENDS & TECHNOLOGIES SHAPING THE PERSONAL COMPUTER MARKET

Intel's Media-Rich Net

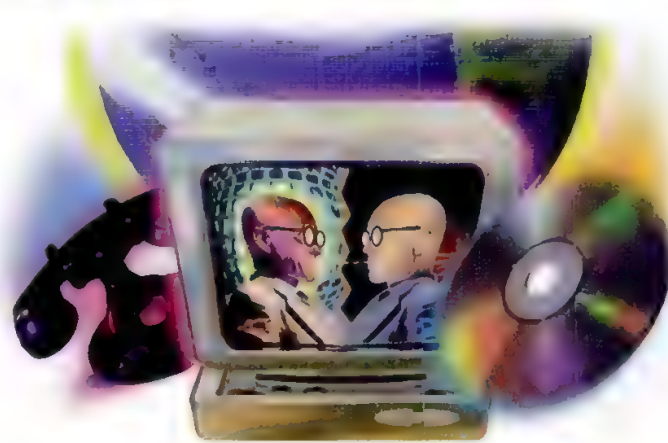
CEO Grove bets on local bandwidth.

A year ago, at a television industry meeting, I predicted that PC viewing hours will soon exceed TV viewing hours in the average household, with the Internet driving the trend," said Intel CEO Andy Grove at Intel's recent jam-packed Internet Media Symposium.

Intel's event plotted a technology road map toward "hybrid media applications," with 3-D worlds, audio, and video converging on high-bandwidth PCs. A crowd-pleasing demonstration of a hybrid app kicked off the event. The demo featured a CD-ROM, produced by Epic Records in CD Extra format, that included music, video, and a launching pad to a Web- and avatar-based 3-D world called Blues Shack.

Intel launched a transcontinental videoconference within the 3-D world, featuring an Epic Records recording artist who sang live from France. Intel's Grove explained that the demo combined local, CD-ROM, and hard disk-based media types, along with server-based "remote" media types, such as streaming video.

Because of bandwidth challenges, Grove emphasized, the Internet's move toward a rich, multimedia experience can't rely solely on new pipes and greater remote bandwidth. He said that ISDN was a huge disappointment and that T1 and T3 pipes were the province of corporations, not homes. Instead of rushing toward bigger pipes, he said, designers must scale new applications so that they combine local storage with remote services.



In the address that followed Grove's, Intel's Mike Aymar pointed to DVD (Digital Versatile Disk), video running over the plain old telephone service, and 8X CD-ROM drives as the key parts of the local-bandwidth equation. Aymar said Intel is very focused on ensuring that in 1997, PCs under \$2,000 will be capable of digital imaging, video editing, arcade-quality 3-D entertainment within virtual worlds, and Web-based technical support with simultaneous voice and data transmission.

Aymar identified Intel's MMX technology, running on Pentium Pro chips, as the goal for facilitating new Internet media types. He also cited a quote from Intel chairman Gordon Moore: "If the auto industry advanced as rapidly as semiconductors, a Rolls Royce would now get half a million miles per gallon, and it would be cheaper to throw it away than to park it."

With data from the cable industry, Aymar underscored Grove's

theory on "PC viewing hours." Analysts estimate that though Americans spend twice as much time watching TV as using PCs, by

the year 2005 they'll spend twice as much time with PCs as with TVs.

Intel also announced its Internet Media Developers Support Program and a resource center to help companies design hybrid apps. The facilities at the Intel Architecture Labs in Oregon will propel developers toward MMX, DVD, Intel's Internet phone technology, and its ProShare video-conferencing software.

Intel's vision of connected PCs that deliver voice, video, 3-D, and animation has brought about some new Internet applications, available at Intel's Web site. The first is the Intel Internet Software Update Manager, which lets you automatically retrieve, install, and update plug-ins and helper apps. The second is the Intel Guided Tour, a Java applet designed to simplify tours of Web content on specific topics that you choose.—*Sebastian Rupley*

What PC Slowdown?

Latest figures point to a healthy market.

IBM

Considering the dismal performance of technology stocks over the summer, you'd think the computer industry is in for a big slowdown. Not so, say market-research firms International Data Corp. and Dataquest—they predict the PC industry is on track for a healthy year.

According to both firms, the PC market is sustaining double-digit growth. Preliminary figures from IDC report that nearly 6 million units shipped in the U.S. in the second quarter of this year, an 18-percent growth from the same period in 1995. Dataquest reports a slightly lower growth of 16.5 percent. Both firms also report that Compaq remains the market-share leader, controlling around one tenth of the market, and that IBM performed aggressively, growing over 30 percent in the U.S.

For the U.S., Dataquest estimates that Dell had the best second-quarter growth, with a 76-percent increase over last year's, and that Hewlett-Packard, IBM, and NEC each shipped 30 percent more PCs worldwide than they did last year. According to IDC's market-share rankings, the top five vendors are Compaq, Packard Bell, IBM, Apple, and Dell. IDC predicts that over the rest of 1996, 27 million PCs will be sold in the U.S., compared with the 23 million sold last year.—*Carol Levin*

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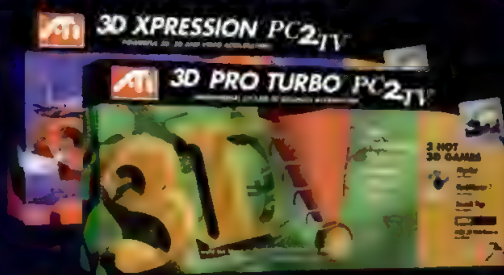
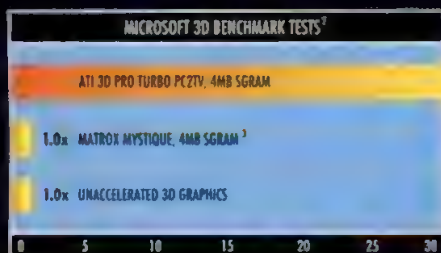
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© ATI Technologies Inc., 1996. ATI, 3D PRO TURBO, 3D XPRESSION and PC2TV are trademarks and/or registered trademarks of their respective manufacturers. 1. All performance tests conducted on a P5-166MHz system with 32MB EDO RAM, 256K cache. The 3D XPRESSION PC2TV, Matrox Mystique and Diamond Stealth 3D 2000 are configured with 2MB of memory and the 3D PRO TURBO PC2TV and Matrox Millennium with 4MB of memory, for PCI bus using driver release: 3.0, 1.0, 1.0, 3.0 and 2.2 respectively. WinBench tests conducted at 1024x768 resolution at 256 colors or 75Hz refresh under Windows 95. 2. Test conducted on a P5-75MHz system with Microsoft Tunnel Test in 640x480 resolution at 65K colors in bilinear. 3. Bilinear texturing not supported in hardware.

CIRCLE 059 ON READER SERVICE CARD

Micropanel Breakthroughs

New projection displays reflect the big picture.

Display manufacturers exploring new technologies are finding that reflective micropanels may hold the key to lightweight, affordable projection displays—self-contained systems that combine the light source of an overhead projector with a color LCD panel.

Micropanels are made using standard low-cost techniques, and their reflective design allows more light from the source to project through to the user's eyes. Conventional liquid crystal displays (LCDs), on the other hand, have large transistors at each pixel that block transmitted light and require power-hungry backlights. Higher resolutions require more transistors, which increases the problem of getting a cost-efficient yield from production lines.

Three manufacturers are taking different approaches to reflective micropanels. Texas Instruments' Digital Light Processor (DLP) uses tiny square mirrors mounted on diagonal hinges. Each mirror can be positioned to reflect light through or away from the projection optics. Projectors with 800-by-600 resolutions are already on the market.

A joint project of Hitachi and Raychem Corp. has created a LCD fixed-mirror design, which the companies estimate can be two to three times brighter than traditional LCD projectors. Standard LCDs use a

layer of liquid crystal material to twist light so that polarizing filters can block or transmit it. These filters also consume much of the light that the LCD transmits.

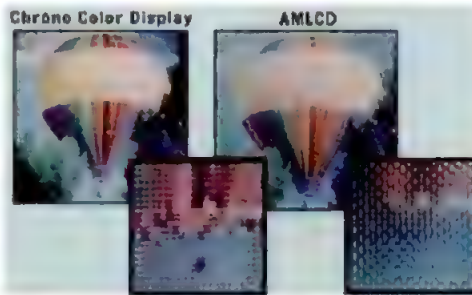
The new fixed-mirror design encapsulates drops of the liquid crystal material in plastic polymer material. In an "on" state, the crystals line

up vertically, letting light pass through. When "off," the crystals arrange themselves randomly and scatter light. Small transistors switch the encapsulated liquid crystals on and off. Since more than 90 percent of the panel's surface is reflective, it's far brighter than a traditional LCD.

In the Chrono Color panel developed by Displaytech, a new company from Boulder, Colorado, the semiconductor's reflective surface serves as an electrode for the display cell. The cells use a thin layer of ferroelectric liquid crystal material—about one-fifth to one-eighth the thickness of a standard LCD panel—that provides fast switching. This design makes it possible to create pixels as small as 10 microns square, which means that a 1,024-by-768 display could fit on a half-an-inch-wide chip.

Unlike some designs that use colored filters and three or four cells per pixel, the Chrono Color panel uses only one cell per pixel. Red, green, and blue light sources illuminate the entire panel in sequence. These three images are created so rapidly that your brain combines them to create a full-color image.

The Chrono Color's illumination method requires extremely fast cell switching. To create a 60-Hz image, the cells must switch off or on at least 180 times per second. The ferroelectric liquid crystal provides this rapid response.—*Alfred Poor*



SHARPER IMAGE: Images projected from a Chrono Color display show finer detail—as shown in the close-up—because each cell is a distinct color. The LCD panel requires four cells to produce one color.

Virtual Plastic

Banks to issue digital Visas.



Security concerns have held back Web-based commerce, but Visa and VeriSign are getting close to what could be widespread, secure credit-card transactions.

VeriSign is aiming to provide authentication services for Visa's "virtual" credit cards by the beginning of next year. The Visa/VeriSign system calls for

VeriSign to provide digital authentication certificates based on the Secure Electronic Transactions (SET) standard, which is also backed by MasterCard, GTE, IBM, Microsoft, Netscape, SAIC, Terisa Systems, and Verifone. SET calls for encoded digital certificates that people can use as the equivalent of credit cards for electronic transactions. VeriSign will provide the service on behalf of Visa, which, in turn, will make it available for Visa-accepting financial institutions.

According to Steve Herz, senior vice president of electronic commerce at Visa International, "Banks will be able to offer their cardholders and merchants 'bank-branded' certificates for conducting secure business."

In practical terms, after selecting your purchases on the Web, you'll click on a credit-card icon that's linked to your unique "decoder key." Then you'll fill out an e-mail form that

includes the decoder key, a list of the items you want to purchase, and a digital certificate, and pinpoints the bank that issued the Visa card. The merchant uses the decoder key to process the order.

VeriSign's Web site will make

SET test certificates available for application developers who intend to sell SET-certified products. Later this year, commercial tests will take place. And by the first quarter of 1997, Visa hopes to be issuing digital credit cards.—*Sebastian Rupley*

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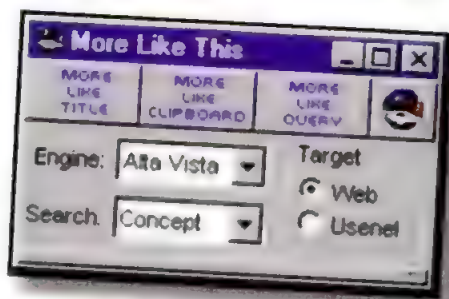
Searching for Meaning

How to craft the perfect query.

A fundamental problem is looming on the Web: As the volume of content is ballooning, the quality of search results is decreasing.

Developers such as Excite, with its new "intelligent concept extraction," and Empirical Media, with its "collaborative filtering," are hard at work on the problem. And now, the Hong Kong-based company Knowledge Discovery is taking a swing at it.

Neither a search engine nor an off-line search tool, the company's software, called More Like This, is a "search query generator" designed to improve search results



TELL ME MORE: Search query generator More Like This is designed for quick Web searching.

and simplify the search process. "The amount of irrelevant material on the Internet is expanding more rapidly than the amount of

relevant material," says Scott Deerwester, a founding partner of Knowledge Discovery. The hard part about searching the Web, Deerwester explains, is "figuring out the right thing to say." So his software, based on concept-based searching, refines a query with additional words.

For instance, if you want to search on the word *pope*, More Like This adds *papal* and the Italian news agency *ANSA* to the query before delivering it to a Web search engine. Knowledge Discovery has two patents on the techniques for coming up with such words.

Deerwester, who worked for Bellcore to help develop "latent semantic indexing," an information-retrieval method explains that the software identifies underlying patterns and relationships among topics. He found a way to research nearly a million Web pages and to distill billions of topics down to 15,000 major subjects.

More Like This also simplifies access to Web search engines. Rather than typing a search site's address, you can click the on-screen button and type a query. More Like This then delivers it to the search engine you choose.

Knowledge Discovery, a six-person firm, is counting on the Web's "bubble-up" phenomenon to work: If the software is good, it'll get onto one hot list, then another, and another. —Carol Levin

Microsoft and Apple Vie for Games Developers

Can Apple tempt developers away from Microsoft?

Behind the screen, the computer game industry is anything but fun and games: It's a highly competitive and lucrative field that's at a crossroads. Both Microsoft and Apple are heavily recruiting developers to their 3-D development platforms.

In June, Microsoft shipped Direct3D to developers, its framework for the hardware-based acceleration of 3-D games. This release followed an eight-month delay, during which de-

velopers waited anxiously for the component in order to complete their games. Prior to this delay, games development was in a state of confusion. Microsoft had redrawn its strategy from what was called Win/G to DirectX, a set of components for Windows games development that includes DirectDraw (the composition engine for graphics and video that enables smooth animation), DirectInput, and DirectPlay (for multiplayer gaming over the Internet). Another com-

ponent of DirectX is Direct3D, which is based on Reality Lab technology that Microsoft acquired from Rendermorphics. The result is a tightly integrated games development platform that ties in 3-D graphics, sound, input, and the Internet. But during these delays, the competition wasn't just sitting around.

Enter Apple Computer. Having succeeded in elevating QuickTime as a standard for video recording and playback, Apple is now working overtime to establish its new QuickDraw 3D RAVE (Rendering Acceleration Virtual Engine) as the king of 3-D game development.

Apple is offering compelling advantages for games developers. Since QuickDraw 3D is cross-platform, they can produce games for both Macintosh and Windows and release both versions simultaneously. Apple also claims that RAVE lets games developers capitalize on their existing technologies—a

key issue for those who wish to differentiate their content from that of the competition.

Another key component of QuickDraw 3D is a file format called 3D metafile or 3DMF, which overcomes the difficulties that have dogged 3-D graphics in the past. It's a cross-platform, cross-application format that supports not only 3-D geometry but also the information that



QuickDraw 3D RAVE

represents a view or scene.

Still, Apple faces a formidable competitor as Microsoft continues to attract games developers. As of August, there were 200 titles based on DirectDraw, and two games—Microsoft's *Monster Truck* and Activision's *HyperBlade*—based on Direct3D. Only *Havoc*, from Reality Bytes, uses Apple's 3-D technology. The outcome of this game is still undecided. —Carol Levin

Top CD-ROMs

- 1 **Duke Nukem 3D** 3D Realms Entertainment
- 2 **Microsoft Windows 95 Upgrade** Microsoft
- 3 **Warcraft II: Tides of Darkness** Blizzard Entertainment
- 4 **Corel WordPerfect Suite Upgrade** Corel
- 5 **Toy Story Animated StoryBook** Disney
- 6 **Civilization II** MicroProse Software
- 7 **Myst** Broderbund Software
- 8 **TripMaker** Rand McNally
- 9 **AN-640 Longbow** Origin
- 10 **Command & Conquer** Virgin Interactive

*Source: PC Data. Data for June 1996.

By Jake Kirchner

Planning a RAM Upgrade? Wait No Longer!

If you've been in the market for additional memory for your turtle of a PC but have been paralyzed by the freefall of RAM prices over the last six months, wait no longer. All indications are that prices have bottomed out. In fact, they may well start inching upward in the coming months as a result of several pronounced trends in the world PC markets.

Since the beginning of the year, the cost of adding 8 megabytes to your desktop has decreased by half and almost half again, with a surplus of RAM chips afflicting many overeager vendors. At the same time, the market has experienced a worldwide glut of chips as leading vendors, particularly in Pacific Rim countries, have jockeyed for dominance and international bragging rights.

The result has been an unprecedented buyers' market: Many memory makers have had to sell chips at below cost in order to move inventory and keep their plants running. Gary MacDonald, marketing vice president of leading chip seller Kingston Technology Corp., observed that the memory business has become "a question of who can bleed the longest."

Trying to stanch the bleeding, many leading chip manufacturers, particularly in Japan, have recently announced plans to slow production until demand picks up. The good news for them is that demand is about to heat up rapidly.

The pace of PC sales continues to be strong if not breathtaking. Recent forecasts for the rest of the year have PC sales humming along at 18 percent to 20 percent above last year's pace. That's not as impressive as last year's increase over 1994, but it's still strong enough to keep a lot of memory chips moving out.



Memory prices have bottomed out and may well start inching upward in the coming months.

Many systems vendors have been offering special memory-upgrade deals in the effort to clear their chip inventory. Some are even offering free 8-megabyte upgrades to help sales. But a glance at advertised prices suggests that at least a few companies have used the skydiving wholesale prices to make a better-than-usual profit with their "special" end-user prices. In other words, you pay them a great price for chips they got at an unbelievable price. Nonetheless, the net effect is a big inventory draw-down.

Of course, the amount of RAM in the average desktop PC continues to grow, further depleting the stock of available chips. Today there are few PCs that ship with less than 8 megabytes, and 16 is more the norm, especially on machines preinstalled with Windows 95.

The other factor in this supply-and-demand equation is the introduction of Windows NT 4.0. Most corporations may have passed on Windows 95, but this time, the pundits say, they're going to get off their hands and upgrade to the new operating system. There are warring estimates of the rate of Windows NT 4.0 adoption; it's safe to say that in the coming

months, corporations will upgrade hundreds of thousands of machines, perhaps millions, to the new version. And the base system for Windows NT is more likely to include 24 or 32 megabytes of RAM than 16.

No doubt the RAM market still has some surprises in store for us, and some special deals may still crop up. But the overall trend is unmistakable: RAM prices have hit bottom. They may not shoot up right away, but there is only one direction for them to go.

Ready to Rock?

More fans for Enhanced CD.

The hybrid medium known as Enhanced Compact Disk (ECD) adds a whole new multimedia dimension to audio CDs, but consumers have been slow to catch on. ECD has been hobbled by a morass of technical and marketing snafus. That's changing now that a group of industry giants, including Microsoft, Apple, and the Recording Industry Association of America (RIAA), have put their combined weight behind the first real standard, called Blue Book or CD Extra, for manufacturing ECDs.

ECDs play exactly like standard audio CDs in audio players;

they reveal their multimedia content when loaded into compatible CD-ROM drives. Sounds simple enough, but ECD entered the market without the benefit of a unifying standard, and that spelled trouble.

Many CD-ROM drives still don't recognize the data portions of some or all of the disks, but that situation is rapidly improving now that a growing number of drive manufacturers have made compatibility with the format a priority.

The splintered format situation has settled down, with nearly all ECDs being recorded in either of two ways: So-called "pre-gap" disks place multimedia data in the area preceding the first audio track. Audio players ignore the multimedia data and proceed

directly to the first audio track. Compatible CD-ROM drives recognize the multimedia data and load it as they would any CD-ROM content.

Sony and Phillips, in conjunction with Microsoft and Apple, have developed the Blue Book standard, in which multimedia data comes after the disk's audio portion.

MUSIC AND VIDEO: CDs are moving to a multimedia standard



After an initial period of confusion, the recording industry seems to be falling in behind ECD. The RIAA has an Enhanced CD certification program that encompasses both pre-gap and Blue Book.

In order for ECD to survive, the disks must work in any CD-ROM drive, and they must be available at a reasonable price. That will require improved cooperation between operating system developers, drive manufacturers, and content providers. If all of these players can work together, multimedia content may become as ubiquitous as the paper booklets that accompany audio CDs today.—Jonathan Matzkin

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

NOTEBOOKS

At 150 MHz, Does Intel's Fastest Mobile Pentium Make Sense?

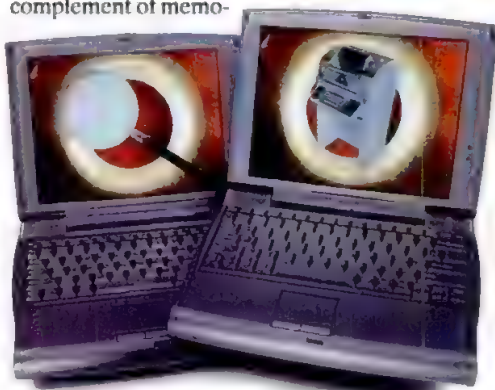
By Mary Behr and Cade Metz

Intel's new 150-MHz mobile Pentium processor is like a prize thoroughbred on a wet track: It may be faster than its competitors, but surrounding conditions nearly eliminate its advantage.

Although the 150-MHz processor raises the top clock speed for mobile processors by almost 13 percent from its 133-MHz predecessor, its dependence on a 60-MHz system bus limits overall performance. The Pentium/133 can't match the raw speed of the Pentium/150 processor, but systems using the Pentium/133 chip can take advantage of a faster 66-MHz bus. Pentium/133 systems are also between \$200 and \$600 less expensive, making them the value choice for high-end performance notebook buyers.

In side-by-side testing of these near-identical twins, we found that the first three mobile Pentium/150 notebooks—the Acer-Note Nuovo, the Digital HiNote Ultra II, and the Micron Millennia TransPort—performed at levels

that were virtually indistinguishable from their Pentium/133 siblings. In the light of the recent drop in memory prices, we think that increasing the notebook's complement of memo-



ACTIVE ACER: The Nuovo's design offers the best battery life of any high-performance notebook available today.

ry to 32MB makes more sense than pushing the CPU's speed limit (see the sidebar "Desperately Seeking Value").

UP NEXT: MMX

The mobile Pentium/150 will find some ready competition. When Intel introduces its first mobile

MMX (multimedia extensions) chip in early 1997, it will likely have a clock speed of 166 MHz, use a 66-MHz bus, and be more of a step up from the mobile

Pentium/133 in terms of performance than the Pentium/150. Expect to see faster MMX chips as well, although early indications are that due to overheating problems they will at first fall short of the 200-MHz level that marks the top speed for desktop PCs. Look for Pentium Pro

notebooks in 1998.

Intel manufactures the mobile Pentium/150 using a 0.35 micron process and mounts the final product onto a Tape Carrier Package—a design that is smaller, thinner, and lighter than the ceramic base used on desktop PCs. While interfacing with

external components at 3.3 volts, the computational core runs internally at 3.1 volts via Voltage Reduction Technology (VRT). This doesn't match the 2.9 internal voltage of the Pentium/133, but peak power consumption is still a battery-friendly 7.2 watts, which is comfortably under Intel's 8-watt power ceiling for portable CPUs.

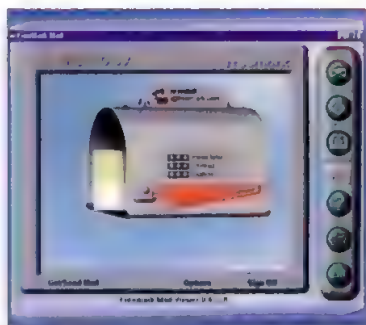
In addition to the mobile Pentium's SL power management technology, Intel has teamed up with several other companies to promote power-conservation operating-system standards: ACPI (Advanced Configuration Power Interface) and APM (Advanced Power Management). Intel has also teamed up with Duracell in a stalled effort to create a smart-battery standard, and the Intel Processor Module—which incorporates the CPU, the secondary cache, and part of the chip set into a single entity—could be available by the middle of 1997.

All this adds up to a generation of more powerful portables coming in the new year.

THE FORK NOT TAKEN

Although the HiNote, Nuovo, and TransPort are in the vanguard of Pentium/150 notebooks, they will not be alone. Other major notebook sellers,

IN THIS EDITION OF FIRST LOOKS

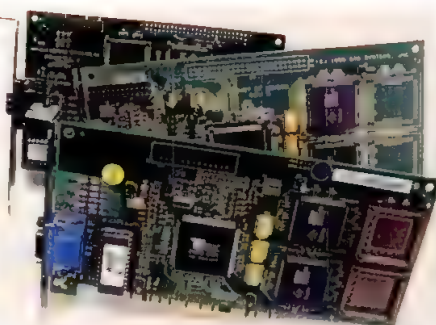


◀ E-MAIL, GRATIS:

New e-mail services use advertising to bring you free e-mail. See page 44.

FAST VIDEO: ▶

New 128-bit graphics accelerators deliver performance at an affordable price. See reviews on page 66.



OmniPage Pro.....	43
TextBridge Pro 96.....	43
Broadway.....	48
REALmagic Ultra.....	51
PC Support on the Web.....	52
Snagit.....	52
Submit THIS! 1.0.....	58
Connectix Color QuickCam.....	60
WinCam.One.....	60
ColorWorks 2.0.....	63
MultiMedia MM100.....	63
Corel Presentations 7.....	69
CrystalLake Sound Card.....	69
CrystalLake Speakers.....	69

First Looks

including Compaq, Dell, IBM, Texas Instruments, and Toshiba, will have Pentium/150 systems ready by early fall. Others, including Hewlett-Packard, have chosen not to take the Pentium/150 fork in the CPU road, preferring to wait for faster, MMX-ready processors for their next-generation notebooks.

Each of the three notebooks we reviewed will appeal to a specific audience. The HiNote packs a lot of PC into a small, light case, while the Nuovo is the last word in battery life, and the TransPort is the performance leader. Though these Pentium/150 notebooks don't leave their Pentium/133 mates in the dust, they represent a step up the processor ladder.

For those who require squeezing the last drop of performance out of their notebooks, the Pentium/150 makes sense. For those more concerned with value, more memory in a Pentium/133 notebook is the key.

ACERNOTE NUOVO

While diverging from Acer's previous portables, the \$3,999

Nuovo Pentium/133 and \$4,599 Nuovo Pentium/150 provide stellar performance, an exceptional array of features, and pace-setting battery life.

The 7-pound Nuovo has a rounded, charcoal-color case, a keyboard that tilts up at the flip of a switch, and a clear 11.8-inch active-matrix SVGA display. A touch pad is located just to the left of the case's center, an integrated speaker resides on either side of the display's hinge, and a modular bay accommodates a 6X Toshiba CD-ROM drive or a 1.44MB floppy disk drive.

The Nuovo's lack of a power switch is both a major strength and a weakness. Close the display to put the Nuovo into sleep mode and store system contents to either memory or disk; open it and the unit wakes up where you left off. The system's Sleep Manager software supplements such power management techniques with an addi-

tional 0-volt, APM-based suspend mode that completely shuts the system down.

Even with this power management turned off, the Nuovos attained battery life of an incredible 6 hours 6 minutes for the Pentium/150 and 4 hours 38

the Nuovo's mission. The system provides a rear IrDA infrared interface, an integrated 28.8-Kbps fax/data modem with full DSVD support, and a built-in microphone.

In testing, the Nuovos handily outperformed the average presentation-class machine in our most recent notebook roundup ("Portable Property," August 1996). With 256K of external cache, 16MB of EDO RAM, and a 128-bit NeoMagic Magic-Graph128V graphics chip set with 2MB of EDO RAM, these results need no further explanation. The Nuovos' 6X Toshiba CD-ROM drives produced two of the highest CD-ROM WinMark 96 scores that we've seen from a notebook. Although the two Nuovos had the same 1.2GB IBM hard disk, the 150-MHz Nuovo inexplicably delivered a lower Disk WinMark 96 score.

The Nuovo weighs the same as the IBM ThinkPad 760ED but runs nearly twice as long between charges. The Nuovo resolves the compromises between battery life and performance better than anything else we've seen.

AcerNote Nuovo. List price: With 16MB RAM, 1.2GB hard disk, 11.8-inch active-matrix display, \$3,999 (Pentium/133); \$4,599 (Pentium/150). Acer America Corp., San Jose, CA; 800-733-2237, 408-432-6200; www.acer.com/aac. Circle 434 on reader service card.



MIGHTY MITE: Digital's HiNote Ultra II squeezes a powerful multimedia notebook into a small, light case.

minutes for the Pentium/133 on our BatteryMark tests. On the downside, the only way to restart the system is to use the recessed reset button.

Communications is central to

Desperately Seeking Value

In the continuing argument over which produces a bigger bang for the buck—a faster processor or more memory—additional RAM has prevailed yet again.

Using our pair of Micron

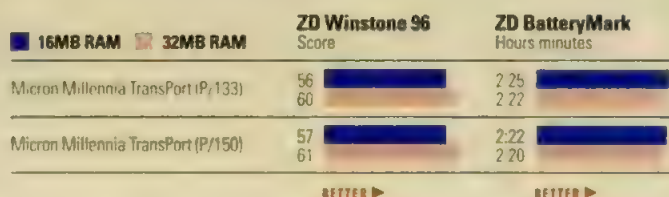
Millennia TransPort systems as directly comparative test-beds, we performed a full suite of tests with both 16MB and 32MB of RAM. We found that the \$200 needed to upgrade the TransPort Pentium/133 to a Pentium/150 processor would be better spent—albeit only slightly—on Micron's \$350 16MB memory upgrade.

With 32MB of memory, the TransPort Pentium/133 scored 60 on our ZD Winstone 96 application suite, which is about 5 percent higher than the score for the TransPort Pentium/150 with 16MB of RAM. The TransPort Pentium/133 uses a 66-MHz bus—not the TransPort Pentium/150's slower 60-MHz bus—so system operations occur faster. This offsets the benefits of a faster processor

on tasks that are not CPU-intensive.

Bear in mind that the Winstone 96 test has a margin of error of between 2 and 5 percent, so many of these test score differences exist only on paper. The 7 percent gain you get from adding 16MB of memory to the Pentium/133 notebook is more meaningful than the 2 percent difference in Winstone scores between the Pentium/133 and Pentium/150 notebooks with 32MB of RAM.

Furthermore, neither boosting the clock speed to 150 MHz nor adding 16MB of memory had much effect on battery life. In short, at a time when RAM modules are cheaper than ever, bulking up on memory makes a lot of sense. —Brian Nadel



HI NOTE ULTRA II

Digital's HiNote Ultra II is one of the slimmest and lightest notebooks on the market, but it sacrifices performance for its svelte profile. Unlike the other twin machines in this review, the \$4,799 HiNote Ultra II Pentium/133 and the \$5,099 HiNote Ultra II Pentium/150 use slightly different hard disks. While this muddled the comparison, it didn't add up to a major performance difference.

The 4-pound HiNote measures only 1.9 by 11.0 by 9.0 inches, yet it manages to squeeze in

First Looks

an 11.3-inch active-matrix display. Its hinged battery rotates to give the keyboard an upward tilt. In front of its somewhat cramped keyboard, there's a trackball and an ample wrist rest.

The system includes a wedge-shaped floppy disk drive that attaches to the bottom of the case. For an additional \$200, you can add a second Type III PC Card slot—which doubles as two Types II slots. Digital's \$699 Mobile Media Module weighs an extra 1.9 pounds and includes a 6X Toshiba CD-ROM drive and high quality stereo speakers, but it doesn't contain a floppy disk drive and can't be used with the floppy disk add-on.

Though benchmark test scores for the HiNote were well below those of the other systems in this group of first Pentium/150 notebooks, most were close to the average scores from our most recent notebook roundup. The HiNote's key components—16MB of DRAM, 256K of external cache and a Cirrus Logic 65548A graphics chip set with 1MB SRAM—are certainly laudable.

Direct comparisons between the HiNotes are difficult because the 150-MHz version has a 1.44GB IBM hard disk and the 133-MHz version has a 1.35GB Toshiba drive; the two drives are able to read and write data at different rates. Due in part to these different

hard disks, the Pentium/150 system turned in slightly higher Winstone 96 and Winstone 32 scores.

Thicker, bigger, and with a smaller screen than the IBM ThinkPad 560, the Digital HiNote Ultra II weighs slightly less. Digital has traded high-end performance for a notebook that can go anywhere you do.

HiNote Ultra II. Street price: With 16MB RAM, 1.35GB hard disk, 11.3-inch active-matrix display. \$4,799 (Pentium/133); with 16MB RAM, 1.44GB hard disk, 11.3-inch active-matrix display \$5,099 (Pentium/150). Digital Equipment Corp., Maynard, MA; 800-642-4532; fax, 800-652-4532; www.pc.digital.com. Circle 435 on reader service card.

MICRON MILLENNIA TRANSPORT

Micron's Millennium TransPort has avoided the sophomore slump. After an Editors' Choice-winning debut ("Portable Property," August 1996), the TransPort turned in slightly higher benchmark test results for this story.

Micron engineers have so adeptly optimized the Pentium/133 TransPort that any dif-

ferences with the Pentium/150 incarnation are imperceptible. The \$5,298 TransPort Pentium/150, however, costs only \$200 dollars more than the 133-MHz system.

At 7.5 pounds, the TransPort is the heavyweight of this group, but its handsome, angular case holds an impressive collection of high-end components. Unlike the Nuovo and the HiNote, it integrates both a floppy disk drive



TOP PERFORMER: The Micron Millennium TransPort offers everything a desktop PC does, but it comes in at less than eight pounds.

and an 8X CD-ROM drive directly into the chassis. It also offers a 12.1-inch active-matrix SVGA display and an integrated microphone as well as both front and rear IrDA ports, which ease positioning for wireless transfers.

Although the two can't be used

at the same time, the TransPort provides both a touch pad and a pointing stick. The machine's rear panel is equipped with both NTSC video-out and S-Video-out jacks as well as the standard set of ports. The \$299 Micron Dock Multimedia Port Replicator contains an Ethernet adapter, a SCSI-2 port, and a better set of stereo speakers than the pair integrated into the wrist rest.

With 16MB of EDO RAM and 256K of external cache, these two machines turned in stellar benchmark test results that set the pace. Except for modest Graphics WinMark 96 and BatteryMark results, their scores bested those of this summer's average presentation class system in every category. And their 2.1GB IBM hard disks (the largest of the group) helped them earn the highest Disk WinMark 96 and Winstone 32 scores we've ever seen on a portable.

At about the same heft and size as the IBM ThinkPad 760ED, the TransPort is the performance king of the desktop-replacement set.

Millennia TransPort. Direct price: With 16MB RAM, 2.1GB hard disk, 12.1-inch active-matrix display, \$5,098 (Pentium/133); \$5,298 (Pentium/150). Micron Electronics Inc., Nampa, ID; 800-388-6334, 208-893-3434; www.mei.micron.com. Circle 436 on reader service card.

BENCHMARK TESTS

High-Performance Notebooks



With little or no margin separating their ZD Winstone scores, the Pentium/133 and Pentium/150 versions of the notebooks we tested fought their way to a stalemate in terms of overall application performance. In some cases, the faster processor actually degraded performance, as seen with the two Micron Millennium TransPorts' ZD Winstone 32 scores. The biggest surprise was the Nuovo Pentium/150's battery run-

down time, which was 1 hour 28 minutes longer than the same system's score with a Pentium/133 CPU.

To measure performance, we used ZD Winstone 96, Version 1.0; ZD Winstone 32, Version 1.0; and ZD WinBench 96, Version 1.0. To gauge the battery life of these portable PCs, we ran ZD BatteryMark. Each unit was equipped with 16MB of RAM and ran Microsoft Windows 95.

Higher scores represent better performance.	ZD Winstone 96 Score	ZD Winstone 32 Score	ZD Graphics WinMark 96 Mpixels/sec	ZD Disk WinMark 96 Score	ZD CPUmark 16 Score	ZD CPUmark 32 Score	ZD CD-ROM WinMark 96 Score	ZD Battery- Mark Hours:minutes
AcerNote Nuovo (P/133)	52	63	16.1	810	253	247	614	4:38
AcerNote Nuovo (P/150)	54	63	17.3	749	255	245	611	6:06
Digital HiNote Ultra II (P/133)	43	49	11.6	600	187	170	543	2:13
Digital HiNote Ultra II (P/150)	46	53	11.4	717	189	162	542	2:24
Micron Millennium TransPort (P/133)	56	76	12.6	975	250	252	566	2:25
Micron Millennium TransPort (P/150)	57	75	12.8	978	276	267	558	2:22

TravelPro™ 1900,
Intel Pentium® 133 MHz Processor,
12.1" SVGA Active Display,
16MB RAM, 1.3 Gigabyte H.D.

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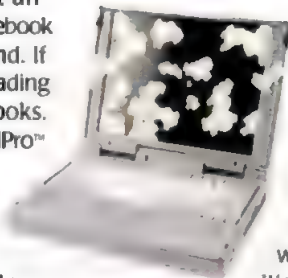
TravelPro™ 1900

Think of it as IMAX™ for your lap.

Hold on to your popcorn, because at an eye-popping 12.1", the AMS TravelPro™ 1900 notebook has one of the largest SVGA displays around. If you think that's impressive, you'll love the leading edge features that tower over other notebooks.

With its modular configuration, the TravelPro™ 1900 gives you exactly what you need without having to pay for what you don't. And that's something that's sure to please even the toughest critics.

With up to an Intel Pentium® 166 MHz Processor, the TravelPro™ 1900 incorporates the fastest Intel Pentium® Processor available. An Intel 430MX Chipset and expandable EDO RAM (35% more powerful than DRAM) give you



overall increased performance.

For a dazzling graphic display under Windows 95, a Neomagic video chip set provides acceleration that's bound to get rave reviews. And thanks to a lightweight, longer life Lithium Ion battery, you can put away your hernia belt and give the battery charger some time off. What really will surprise you, is that while the TravelPro™ 1900 is big on features, it's small on price.

So, if you want a notebook that truly gives you the big picture, go see the new TravelPro™ 1900. Now playing at a lap near you. For more information, call 800-868-8108.

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OPTICAL CHARACTER RECOGNITION

Two Windows 95 Programs That Read the Future of OCR

By Edward Mendelson

New 32-bit versions of optical character recognition (OCR) packages may have arrived late to the Windows 95 party, but the latest iterations of OmniPage Pro and TextBridge Pro are welcome at any time. Both achieve levels of accuracy unimaginable a few years ago, have little trouble handling good-quality faxes, and let you perform OCR without leaving your word processor.

Although these two products perform similarly in terms of speed, they differ entirely in their styles of operation. TextBridge takes the gold in the accuracy event at the OCR Olympics. But OmniPage cooperates better with Windows 95 and has the superior interface.

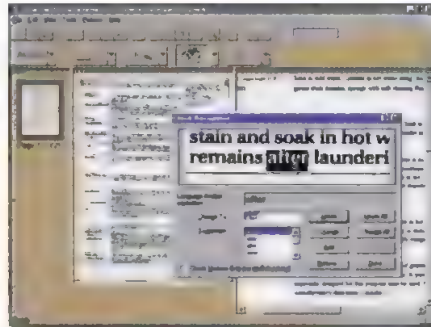
OMNIPAGE PRO

Caere's \$499 OmniPage Pro for Windows 95, Version 7.0, meshes smoothly into other applications and Windows 95, and it has an interface designed for both beginners and experts. You can use OmniPage as a standalone program or run its recognition and proofing functions from the menu of a word processor or spreadsheet. Although its OCR engine is unchanged from the one in Version 6.0, this version adds an OCR wizard that prompts beginners at each step, a clearer interface, and a scheduler for hands-off OCR. The program also can automatically process incoming Microsoft Exchange faxes.

In standalone mode, you can drag zones from OmniPage's viewing window to any OLE 2.0-aware application, such as Microsoft Word. You can save files in all standard word processing formats, as well as in HTML.

The program's toolbar controls automatic or manual pro-

cessing: The left pane displays thumbnails of the current job, while the center pane has an enlarged image for zoning, and the right pane shows recognized text with doubtful words color-coded



DEEP ANALYSIS: OmniPage's language analyst accurately identified this word but offered to change it in case it was incorrect.

according to the program's confidence level. The proofreading tool displays enlarged bitmaps of doubtful words and offers corrections. The training tool requires more manual labor than the one in TextBridge, and it's OmniPage's weak link.

When run from inside a word processor, OmniPage instantly scans a page, optionally lets you identify zones and proofread results, and drops the text at the cursor location. During evaluation, we were impressed with OmniPage's ability to retain the formatting of original documents. Without asking your permission, the program's installation adds an entry to the Windows registry that invisibly loads a background program for running OCR from within other applications.

In handling good-quality input, OmniPage often made more errors than TextBridge on its initial pass through a document. But OmniPage's proofing tool was effective at correcting many of these errors. OmniPage, however, frequently failed to detect the space between two words correctly.

By contrast, with faxes and other documents with poor image quality, OmniPage generally produced more accurate output than TextBridge. Neither package, though, could handle faxes with very small fonts. Unlike TextBridge, OmniPage generates tab-separated text instead of true tables, often with errors. The program can output files in Microsoft Word's .DOC format, instead of the less convenient .RTF clipboard

format used by TextBridge.

OmniPage Pro isn't perfect, but if you buy only one OCR package, this is a good choice.

OmniPage Pro for Windows 95, Version 7.0. Street price: \$500 (upgrade, \$129). Requires: 8MB RAM, 15MB hard disk space, Microsoft Windows 95. Caere Corp., Los Gatos, CA; 800-

535-7226, 408-395-700; www.caere.com. Circle 401 on reader service card.

TEXTBRIDGE PRO 96

Xerox's programmers produced brilliant results when they developed the recognition engine in the \$349 TextBridge Pro 96. The program displays little more than a toolbar over a window used for setting zones and lets you proofread its output only inside your word processor, using a special dialog box and image viewer.

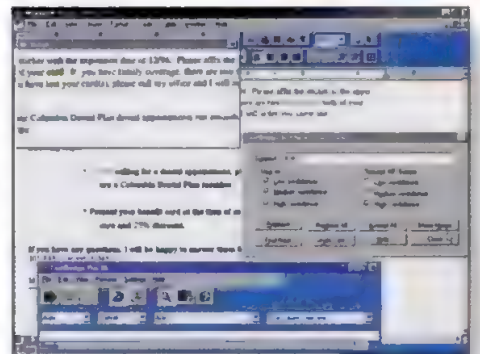
TextBridge can recognize tightly spaced and degraded text that OmniPage can't decipher, and it can generate true word processor tables (complete with cell borders) instead of tab-delimited text. TextBridge sometimes pushed flush-right text beyond the right margin to the edge of the paper, however. The pro-

gram presents the same streamlined interface whether you're in standalone mode or working with your word processor. Interactive training is fast and effortless, and you can save files to the clipboard, most standard word processing formats, and HTML.

The proofreader in TextBridge works with Word, Versions 6 and 7, as well as with WordPerfect for Windows 6.1 (but not with Version 7.0). Doubtful words are marked in color, and you can accept or change them. You can pop up part of the scanned image but only at low magnification. And some of the keyboard shortcuts indicated by underlined letters in the dialog box produce the wrong results. When you run TextBridge from an application, it pastes the recognized text into the application instead of saving it as a file. And unfortunately, you can't turn off its sometimes awkward effort to apply formatting.

TextBridge needs an interface as powerful as its recognition engine, but if you value accuracy over convenience, this is the OCR package to choose.

TextBridge Pro 96. List price: \$349 (upgrade, \$129). Requires: 8MB RAM, 9MB hard disk space,



IN PLACE: TextBridge's in-place proofreader operates entirely within the word processor. The TextBridge window—shown here to illustrate the program—does not need to be open.

Microsoft Windows 95 or Windows NT. Xerox Desktop Document Systems, Peabody, MA; 800-248-6550, ext. 3, 508-977-0764; www.xerox.com/products/tbpro. Circle 402 on reader service card.

ELECTRONIC MAIL

Free-Mail: E-Mail Services Meet Madison Avenue

By Neil Randall

By now, most people are familiar with the many advantages of e-mail: It's fast and easy to use, and you don't need to lick any foul-tasting envelopes or stamps. Taking a cue from the print and television media, several new services are using advertising to offset the cost of providing free e-mail, known as free-mail. Some services, such as Freemark Mail and Juno, are similar to dial-up services; all you need is a modem. A third service, HoTMaiL, takes a more innovative approach, using Internet standards to provide free-mail via your Web browser.

Both approaches have their advantages and disadvantages. But if you're willing to put up with the on-screen advertisements, these new services offer a surprising variety of features and the most economical way to keep in touch.

Registering for these services is an easy enough task: All you have to do is fill in the forms and the providers take care of the rest. Freemark Mail and Juno automatically configure your modem and dial an 800 number to complete the process; HoTMaiL uses your existing Internet account.

To sign-up for these services, however, you must endure an interrogation process. In addition to name and address, you're asked to provide biographical information (sex, age, marital status) occupational status, and, in the case of HoTMaiL, household income. Freemark Mail and Juno also probe you about your buying habits and investments.

Both Freemark Mail and Juno provide you with an e-mail account accessible via either a local phone number or, in Juno's case, if no local number is available, an 800 number. Freemark Mail uses CompuServe's network. Every time you log on, an advertisement appears on your screen. In the case of Freemark Mail, the ad

is part of your actual message screen. Juno and HoTMaiL display banner ads across the top of the window.

Of the two dial-up services, Juno gives you more. But for many users, Freemark Mail makes up for its lack of features with exceptional ease of use. With HoTMaiL, if you know how to surf the Web, then you know how to send e-mail.

Juno's interface looks like a Microsoft Windows program. You can change fonts, text, and background colors; modem configuration; and user profile. You can

intuitive, and that's both a strength and a weakness. Freemark Mail is extremely easy to use; it elects not to place the burden of learning menus and options on users. On the other hand, experienced e-mail users will probably be frustrated by the lack of fonts, folders, priority information, and other important details.

Both Freemark Mail and Juno require that you give your password before accessing your mailbox. You can also create multiple accounts with one installation, each with its own user profile (and

computer with a Web browser. And all of your mail, attachments, message folders, address book entries, and even a signature file are stored on HoTMaiL's server. To access it, you simply point your browser to HoTMaiL's site and enter your name and password.

All of HoTMaiL's functions are accessible from a toolbar across the top of the page. There are several reply options, and you can store mail in customized folders. You can send and receive attachments as long as your browser supports it. During testing, Netscape Navigator 2.0 worked well.

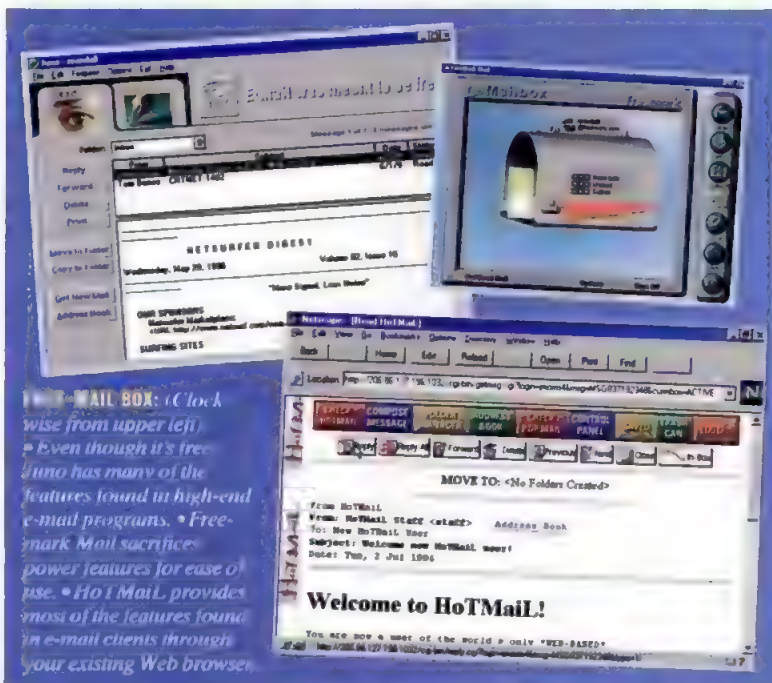
Free-mail is an attractive alternative to commercial mail services, such as MCI Mail, and competes head-on with the established

online service companies. Of the three products we looked at, HoTMaiL provides most of the functionality of e-mail clients without any of the fuss. And the price is hard to beat.

Freemark Mail. List price: Free. Requires: 4MB RAM, 3 to 5MB hard disk space, Microsoft Windows 3.1 or later, or Windows 95, 2,400-bps modem or faster (9,600-bps recommended). Freemark Communications Inc., Cambridge, MA; 800-693-6245, 617-492-6600; www.freemark.com. Circle 407 on reader service card.

HoTMaiL. List price: Free. Requires: Internet access and Web browser (Netscape Navigator 2.0 recommended). HoTMaiL, Fremont, CA; 888-932-6245, 510-440-1181; www.hotmail.com. Circle 408 on reader service card.

Juno. List price: Free. Requires: 4MB RAM, 10MB hard disk space, Microsoft Windows 3.1 or later, or Windows 95, 9,600-bps modem or faster. Juno Online Services, New York, NY; 800-654-5866; www.juno.com. Circle 409 on reader service card.



save messages as text files, save the sender's address to an address book, and even import entire message folders (in MBOX format) from another e-mail program. For security, the program allows you to enable or disable access to your account from another computer. Juno supports folders, although its lack of nested folders is a disappointment.

Freemark Mail more closely resembles the old Prodigy interface than a Windows program. Its screens are big, colorful, and

each receiving tailored ads). Neither program, however, lets you log on from another e-mail account, either through telnet or by changing addresses and host names in the program. This limitation will be an inconvenience for some users, because it means logging off the Internet to get mail.

By contrast, integration with your existing Internet service and software is precisely where HoTMaiL shines. Because the service uses http standards, your mailbox is accessible online from any

STATISTICA

STATISTICA (automatically configures itself for Windows 95 or 3.1) ■ A complete data analysis system with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Comprehensive Windows support, OLE (client and server), DDE, customizable Auto Task toolbars, pop-up menus ■ Multiple data-, results-, and graph-windows with data-graph links ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques with advanced brushing; multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; confirmatory/exploratory factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; correspondence analysis; survival analysis; a large selection of time series modeling/forecasting techniques; structural equation modeling with Monte Carlo simulations; and much more ■ On-line Electronic Manual with comprehensive introductions to each procedure and examples ■ Hypertext-based Stats Advisor expert system ■ Workbooks with multiple AutoOpen documents (e.g., graphs, reports) ■ Extensive data management facilities (fast spreadsheet of unlimited capacity with long formulas, Drag-and-Drop, AutoFill, AutoRecalculate, split-screen/variable-speed scrolling, advanced Clipboard support, DDE links, hot links to graphs, relational merge, data verification/cleaning) ■ Powerful STATISTICA BASIC language (professional development environment) with matrix operations, full graphics support, and interface to external programs (DLLs) ■ Batch command language and editable macros, flexible "turn-key" and automation options, custom-designed procedures can be added to floating Auto Task toolbars ■ All output displayed in Scrollsheets™ (dynamic, customizable, presentation-quality tables with instant 2D, 3D, and multiple graphs) or word processor-style report editor (of unlimited capacity) that combines text and graphs ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) ■ Megabyte Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE, OLE, or an extensive selection of file import/export facilities (incl. ODBC access to virtually all data bases and mainframe files) ■ Hundreds of types of graphs, incl. categorized multiple 2D and 3D graphs, ternary 2D/3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graph types and add them permanently to menus or toolbars ■ On-screen graph customization with advanced drawing tools (e.g., scrolling and editing of complex objects in 32x real zoom mode), compound (nested) OLE documents, Multiple-Graph AutoLayout Wizard, templates, special effects, icons, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of 3D displays ■ Large selection of tools for graphical exploration of data: extensive brushing tools with animation, fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price \$995.

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DIGITAL VIDEO

Put Your Name in Lights with Broadway Video

By Jan Ozer

With a name like Broadway, you'd better deliver exceptional performance. Fortunately for both prospective MPEG developers and Data Translation, the company's \$995 two-pass MPEG encoding system does just that, producing high-quality MPEG files in a fraction of the time required by most software-only encoders. Inexpensive and easy to use, the Broadway system is an ideal product for those making their first foray into MPEG encoding.

Broadway is a two-pass MPEG encoding system that can capture .AVI files in an editable I-frame format; after editing, the system compresses the files into I-, B-, and P-frame-encoded MPEG sequences that require a much lower data rate for playback. Two-pass systems are less expensive than real-time systems and enable video editing on the desktop with such programs as Adobe Premier and Ulead's MediaStudio Pro, which is bundled with Broadway.

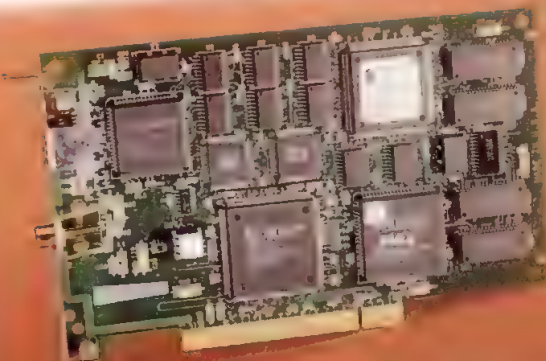
Broadway is the first product to use C-Cube's CLM4110 Video-RISC processor for video capture and MPEG encoding. The CLM-4110 contains C-Cube's most advanced MPEG compression algorithms, making it a perfect complement to Data Translation's technical expertise in producing high-end digital video-editing stations.

PAINLESS INSTALLATION

Broadway is a PCI-bus-master half-length card with S-Video and composite-video inputs. Unlike most other MPEG encoders, Broadway doesn't capture audio, relying on the system's sound card for this task. Hardware extras include stereo audio cables and a composite-video cable, but oddly no S-Video cable. Although Broadway's captured video can be edited in Media Studio and other .AVI-compatible

editing programs, capture and final MPEG encoding must be performed using a simple Microsoft Windows 95 utility that is included with the board

channel selection; and a data rate slider that controls capture quality. Broadway's maximum capture rate is 1.12MB per second,



EASY MPEG: A PCI half-length card with S-Video and composite-video inputs, Broadway is easy to install.

and built around a preview window, eliminating the need for an external NTSC monitor.

We tested Broadway on a Pentium/133 PC with 16MB of RAM, a ProMax Technology 4GB Wide SCSI drive connected to an Adaptec 2940W SCSI card, a sound card, and an Intel Ether-Express PRO/100 network interface card. We captured video from a Sony BetaCAM SP 2600 deck and a laserdisk player.

Setup was effortless, in large part because Broadway requires neither DMA channels nor interrupts, and it needs only one memory address. Windows 95 recognized the Broadway card immediately, the drivers and utility loaded without incident, and after rebooting, the board was ready to capture.

During capture, Broadway produces an .AVI file consisting of MPEG-1 I-frames and uncompressed audio, similar to the motion-JPEG files produced by traditional capture cards. Capture options include hue, saturation, intensity, and contrast adjustments; audio frequency and

which is slow for a PCI card.

In its quest for simplicity, Data Translation omitted some useful features. For example, Broadway's only capture resolutions are 352-by-240 at 30 frames per-second (fps) and 352-by-288 at 25 fps.

In addition, Broadway does not support Windows 95's analog source control over laserdiscs or VISCA decks. And unlike most

prerolling your video and pressing Start to begin the capture and Esc to stop—a hit-or-miss approach. During testing, we captured multiple clips up to 18 minutes long, all at the maximum capture rate. Broadway performed flawlessly on all our tests.

IMPRESSIVE OUTPUT

After capture, you trim unneeded frames using the Broadway utility, which includes an editing time line and fade-to- and fade-from-black transitions. The included MediaStudio Pro editing program provides additional features including titling, transitions, and special effects. We also edited Broadway files in Adobe Premiere 4.2 without a hitch.

After editing, you save the file in Broadway's I-frame format and then load the file into the Broadway utility for compression. You can also compress other .AVI files, but Broadway first converts them to I-frame format at 352-by-240, which can distort the video. Broadway includes compression presets for hard disks, as well as 1X, 2X, and 4X CD-ROM drives—all in 352-by-240, 30-fps format. You can override all data rate presets by individually adjusting compressed video data rates, and compressed audio parameters and data rates.

Noticeably lacking was support for half-VGA 320-by-240 resolution, which would be useful

for developers publishing the same titles in Cinepak, Indeo, or MPEG. Like most low-end MPEG encoders, Broadway provides no controls for GOP order or I-frame placement.

Broadway didn't quite attain the advertised 3:1 compression rate, taking roughly 5 minutes to

compress 1 minute of finished MPEG. In all other respects, however, compression performance was impressive.

Despite the lack of on-board audio capture, Broadway's sound



DESKTOP DIRECTOR: A Broadway utility lets you edit captured video and insert transitions.

other MPEG capture boards, Broadway doesn't provide third-party software for controlling external video decks.

With Broadway, you capture video the old-fashioned way: by



Where Do All The

BIG

Trends Start?

SIoux CITY

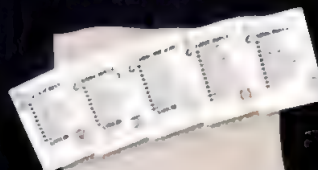




More
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Trends from
Gateway!



February 1988
The bovine species makes its debut in PC advertisements with Gateway's first national ad. Cows become cool.



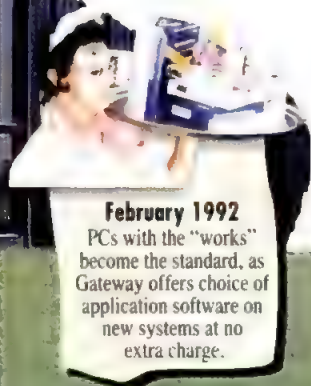
July 1990
The stakes are raised in PC advertising. Gateway pioneers theme ads and easy-to-read bullet-point configurations with the "PC Saloon" ad.



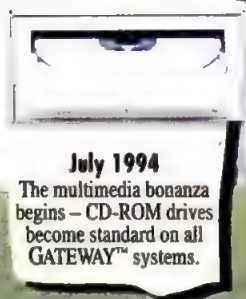
April 1991
Gateway starts shipping PCs in cow-spotted boxes. Cow-spot fever spreads across the nation.

They're **EASY** To Spot In South Dakota!

GATEWAY 2000



February 1992
PCs with the "works"
become the standard, as
Gateway offers choice of
application software on
new systems at no
extra charge.



July 1994
The multimedia bonanza
begins - CD-ROM drives
become standard on all
GATEWAY™ systems.

Gateway Solo 2100 Portable PC

The new Gateway Solo™ 2100 notebook continues the trend of portable PCs we started in 1992. Based on the proven features of the portable PC, Solo 2100 multimedia notebooks deliver all that you want and need. Bigger screens, an all Pentium® processor, zoomed video port, 6X CD-ROM drives and 16MB EDO RAM for less. They start at \$2,699. We've blazed new trails in portable computing — now you can too.

G6-200XL

Gateway led the industry in 1994 by making CD-ROM drives standard on all desktop PCs. Now we've started another trend. CD-ROM drives are standard on our new G6-200XL. This PC features the fastest processor available and 32MB EDO DRAM at an incredible price. Pentium Pro processor-based systems are comparable in performance to Pentium processor based PCs, plus their next-generation platform provides a performance punch when running 32-bit applications like Office 95.

Destination Big Screen PC

After 11 years of rolling out some of the biggest trends in the industry around, we started a trend that will change the way you look at computers forever. It's the Destination™ Big Screen PC. With the features of a multimedia PC with the impact of a big screen, it's a whole new computer category. The 31-inch monitor, wireless mouse and Field Mouse® remote along with the power of a Pentium Pro give you the ultimate multimedia PC. Computing just moved to your family room. Pull up a couch. For the big picture, call Gateway.



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- 1GB 10ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 16-Bit GATEWAY™ Sound Card
- Altec™ Lansing ACS-40 Speakers
- TelePath® 28.8 Fax/Modem for Windows
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- Microsoft® Windows® 95
- Generations II Software Collection

\$1699

P5-166 FAMILY PC

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- 2GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 16-Bit Gateway Sound Card
- Altec Lansing ACS-40 Speakers
- TelePath 28.8 Fax/Modem
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection

\$2449

P5-200 FAMILY PC

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- Matrox® 2MB VRAM PCI Graphics
- 3GB 11ms EIDE Hard Drive
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- 16-Bit Gateway Sound Card
- Altec ACS-40 & ACS-250 Speakers
- TelePath 28.8 Fax/Modem
- 12-Bay Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection

\$2999

G6-200XL

- Intel 200MHz Pentium Pro Processor
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- 256K Internal Cache
- Vivitron 17" .26dp Monitor (15.9" viewable)
- Matrox 2MB VRAM PCI Graphics
- 3GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- CD-Recordable w/ SCSI Controller
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- Altec ACS-400 & ACS-250 Speakers
- TelePath 28.8 Fax/Modem
- 12-Bay Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition
- Generations II Software Collection

\$3899 Business Lease* \$143/mo.

Professional Systems

P5-133

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- 256K Pipelined Burst Cache
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- 1GB 10ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

\$1699 Business Lease* \$63/mo.

P5-166

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- 256K Pipelined Burst Cache
- Vivitron 17" .26dp Monitor (15.9" viewable)
- 2MB MDRAM, 128-Bit PCI Graphics
- 2GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 12-Bay Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

\$2299 Business Lease* \$85/mo.

P5-200

- Intel 200MHz Pentium Processor
- 32MB Synchronous DRAM
- 256K Pipelined Burst Cache
- Vivitron 17" .26dp Monitor (15.9" viewable)
- 2MB MDRAM, 128-Bit PCI Graphics
- 3GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 12-Bay Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

\$2699 Business Lease* \$99/mo.

G6-180

- Intel 180MHz Pentium Pro Processor
- 32MB EDO DRAM
- 256K Internal Cache
- Vivitron 17" .26dp Monitor (15.9" viewable)
- 2MB MDRAM, 128-Bit Graphics
- 3GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 12-Bay Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

\$2699 Business Lease* \$99/mo.

Gateway Solo™ 2100 Portable PCs

S5-100

- 11.3" DSTN SVGA Color Display
- Intel 100MHz Pentium Processor
- 16MB EDO DRAM expandable to 40MB
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- 1MB EDO Video RAM
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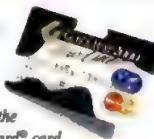
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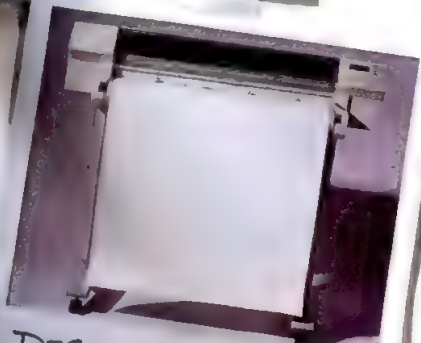
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synchronization proved to be rock solid, even on our 18-minute test clip. Output quality was very high and generally artifact-free but somewhat softer in appearance than clips produced by high-end, real-time encoders. The softness is due to filtering that is automatically performed during capture and that homogenizes the video. This makes the video easier to compress and improves the quality of clips captured from low-end formats.

At \$995, Broadway costs less than most capture card/MPEG compressor software combinations, and it produces better quality video in a much shorter time. It is an excellent solution for most low-volume MPEG applications such as Web pages and multimedia authoring.

Broadway. List price: \$995. Requires: MPC 3-compatible Pentium PC, 8MB RAM (16MB recommended), 100MB hard disk space, SVGA card, audio card with capture capability, open PCI slot, Microsoft Windows 95 or Windows NT. Data Translation Inc., Marlboro, MA; 800-249-1000, 508-481-3700; www.b-way.com. Circle 415 on reader service card.

MULTIMEDIA

REALmagic Ultra: Plug-and-Play Video That Really Works

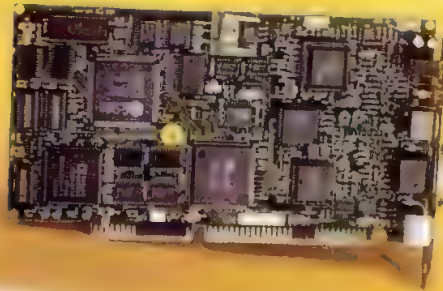
By Jan Ozer

Sigma Designs' \$399 REALmagic Ultra features outstanding big-screen video quality and a new overlay technology that virtually eliminates the compatibility problems associated with many MPEG-1 playback cards. The plug-and-play ISA card provides MPEG-1 audio/video playback and full PCM stereo support, replacing the PC's sound card.

The key is Sigma's EM7110 chip set, which provides both horizontal and vertical filtering. Another proprietary Sigma chip set lets REALmagic Ultra accept analog rather than digital data from the graphics card, avoiding bandwidth limitations and compatibility issues that plagued earlier attempts. The card connects directly to the monitor, accepting

graphics-card output via a proprietary external connector.

The REALmagic Ultra package includes drivers for Microsoft Windows 3.1, Windows 95,



MPEG MASTER: REALmagic Ultra demonstrates the advantages of hardware MPEG.

and Windows NT 3.51, as well as DOS. The card supports both the OM (formerly OM-1) and REALmagic APIs for MPEG, Video CD, and even Karaoke files. There's also a mixer window

for color and brightness adjustment and volume control, a multimedia player, several setup utilities, and an uninstall program.

We tested REALmagic Ultra on a Pentium/133 PC running Windows 95. Installation was simple despite the board's daunting I/O requirements (two interrupts, three DMA channels, and three I/O ports). Windows 95 recognized the board during start-up and prompted us to install the appropriate drivers from a floppy disk.

We synchronized REALmagic Ultra to the graphics card with a Sigma-supplied utility.

Video quality was exceptionally good, even when we scaled the picture to full screen; there wasn't a hint of a jagged edge or aliasing. Even at 1X

resolution, there was much less background noise than with any of the software-only MPEG players. REALmagic Ultra proved stable over a range of configurations with several graphics cards, though we noticed some darkening and slight fuzziness at higher resolutions. REALmagic Ultra stumbled a bit with Number Nine's Imagine 128, exhibiting slight aliasing at 1X playback, which disappeared in full-screen mode.

REALmagic Ultra complied with Windows display protocols by producing a new screen display when switching between applications, a feature not found in many boards of this type. Not surprisingly, we found that REALmagic Ultra was completely compatible with the three REALmagic titles that we tested, and it also played a PAL-based video CD without a problem.

All in all, REALmagic Ultra demonstrates the strengths of hardware MPEG players over software-only players.

REALmagic Ultra. List price: \$399. Requires: PCI slot. Sigma Designs Inc., Fremont, CA; 800-845-8086, 510-770-0100; www.sigmadesigns.com. Circle 416 on reader service card.

FastCD: The Software CD Changer

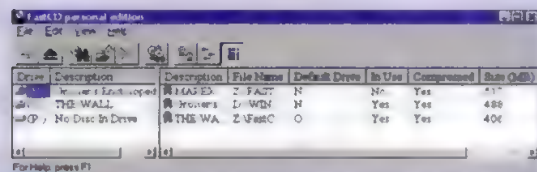
If you've been eyeing a CD changer, you may want to take another look. FastCD Personal Edition, a remarkable \$24.95 utility from Logcraft, may be a more economical solution when combined with a 2GB or larger hard disk—and one that offers a number of advantages over a hard-

ware CD changer.

FastCD works well over a network; you can place CD images on any network drive.

Moreover, you can share the virtual CD drives so that another workstation can access them without having FastCD software or a special driver. On our tests, FastCD compressed a CD image to between 75 and 90 percent of its original size.

Last fall, Stac introduced a similar product called CDShare, but that product used real-mode drivers and required each workstation to run the CDShare software. FastCD is a better solution for Windows 95 users. A 90-day evaluation version is available at the company's Web site (www.logcraft.com), and a Windows NT version should be available by the time you read this.—Barry Simon



JUKEBOX: With FastCD, you can save CD images on your hard disk and they appear in virtual drives on the desktop.

ware CD changer.

FastCD uses the extensibility of the Microsoft Windows 95 file system to set up as many as 24 virtual CD drives on your hard disk. You use the FastCD control program to decide how many virtual CD drives you want, make CD images on

WEB SITES

Technical Support—Courtesy of the Web

By Mary Paulson

Tired of waiting on the telephone for customer and technical support from your PC vendor? Then don't. More and more vendors are increasing the scope of their Web sites from product specifications and prices to include support in an easy-to-navigate format. Though no substitute for a phone conversation or repair visit in dire circumstances, using Web sites for simple problems and questions is just a browser screen away.

In general, the information offered at these sites tends to be basic, with options for viewing, downloading, or subscribing to more detailed documentation. Some sites, however, provide rich detail through discussion forums, question-and-answer sections, and topical search engines. We looked at the Web sites of Apple, Compaq, Gateway 2000, IBM, and Packard Bell (the top five PC vendors) with an eye toward ease of use, layout, content, special features, and, of course, service.

Although these sites can't get you a replacement hard disk or monitor, they can help when you need the latest driver or BIOS revision and even when you want to purchase a new PC online.

APPLE

With Find It navigational aids and a visual map, Apple's Web site (www.apple.com) is about as user-friendly as the Web gets.

Customer support is available via a searchable technical-information library and a discussion forum. In the discussion forum, modeled after Usenet newsgroups, you can post questions publicly and exchange ideas with other users and Apple's engineers, who can provide expert help. For additional product and service information, check out Apple Facts online

or subscribe to one of Apple's online mailing lists.

COMPAQ

Compaq offers one of the most complete vendor Web sites available (www.compaq.com), with excellent explanations of

Compaq also has a special Web-based search and retrieval option, using the company's CD-ROM database with over 35,000 pages of information; the CD-ROM is also available on an annual subscription basis.

The database has an Auto-

GATEWAY 2000

Organized like a computer store, Gateway's Web site (www.gw2k.com) offers a moderate amount of information. The Lobby area provides company information, including the latest annual report. The Showroom is the product area and includes details on every model of Gateway desktop and portable PC, and peripherals. Though technical support is not available directly from the site, you



SIMPLE SITE: Like the Mac OS, Apple's Web site is a friendly environment with navigational aids and a visual map.

CATTLE COUNTRY: Along with product info and tech support, Gateway's site offers a special area for kids and articles on technology trendsetters.

all CompaqCare service and support programs. One of the site's gems is the ability to send questions directly to Compaq technical-support professionals and receive a response by the end of the next business day.

Update feature that allows you to download biweekly supplements. Press releases, product announcements and information, downloadable software files, drivers, self-help tools, and utilities are also available online.

can get contact information and a slew of support documents.

One unique feature is the Reading Room, which contains how-to-find information, an overview of new products and technology, and

Continues on page 58

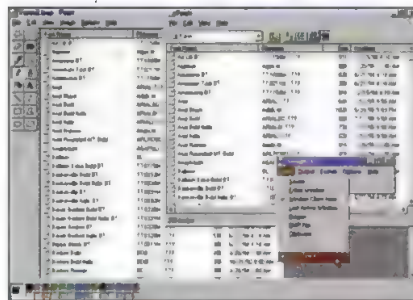
WEB UTILITIES

Snagit Captures More than the Eye Can See

By J.W. Olsen

Sometimes a perfect WYSIWYG screen capture is less than perfect when you try it on the Internet. You may want to capture a giant Web page that scrolls off your browser's window. Enter TechSmith Corp.'s \$39.95 Snagit Twin Pack. Snagit's Auto Scroll option captures what is and what isn't currently visible.

Snagit isn't a full-featured utility like Quarterdeck's HiJaak 95 or JASC's Paint Shop Pro; it can read only .BMP files, writes only six file formats, and can't display graphics. Its image-editing tools allow little more than adjusting RGB balance.



A MOVEABLE FEAST: Snagit's Auto Scroll captures both visible and hidden vertical content.

Snagit easily captures most vertically scrolling windows in their entirety, but not those scrolling horizontally. It captures and prints with one hotkey, and its print options surpass those of competitors.

Snagit captures full DOS screens, but there may be some lost detail.

Snagit can capture full screens, windows, windows' client areas, definable regions, .BMP files, and clipboard contents. Output options include printer, file, clipboard, and MAPI-compliant e-mail.

With its unique features, Snagit is a welcome addition to your graphics toolkit.

Snagit Twin Pack. List price: \$39.95. Requires: 4MB RAM, 1MB hard disk space, Microsoft

Windows 3.x, Windows 95, or Windows NT 3.50 or later. TechSmith Corp., East Lansing, MI; 800-517-3001, 517-333-2100; www.techsmith.com. Circle 433 on reader service card.

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Up to 133MHz Pentium® processor, 256K level 2 cache and up to 16MB expandable EDO RAM all built on 32-bit PCI bus architecture*



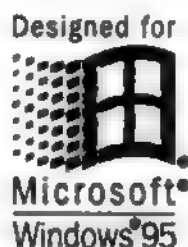
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MAXIMUM PERFORMANCE

*Up to 133MHz Intel Pentium processor,
level 2 cache* and up to 16MB expandable EDO
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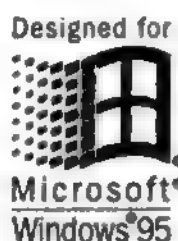
BRILLIANT DISPLAYS

*SVGA color display offers
sharp text and graphics displayed
in crisp 800 x 600 resolution*



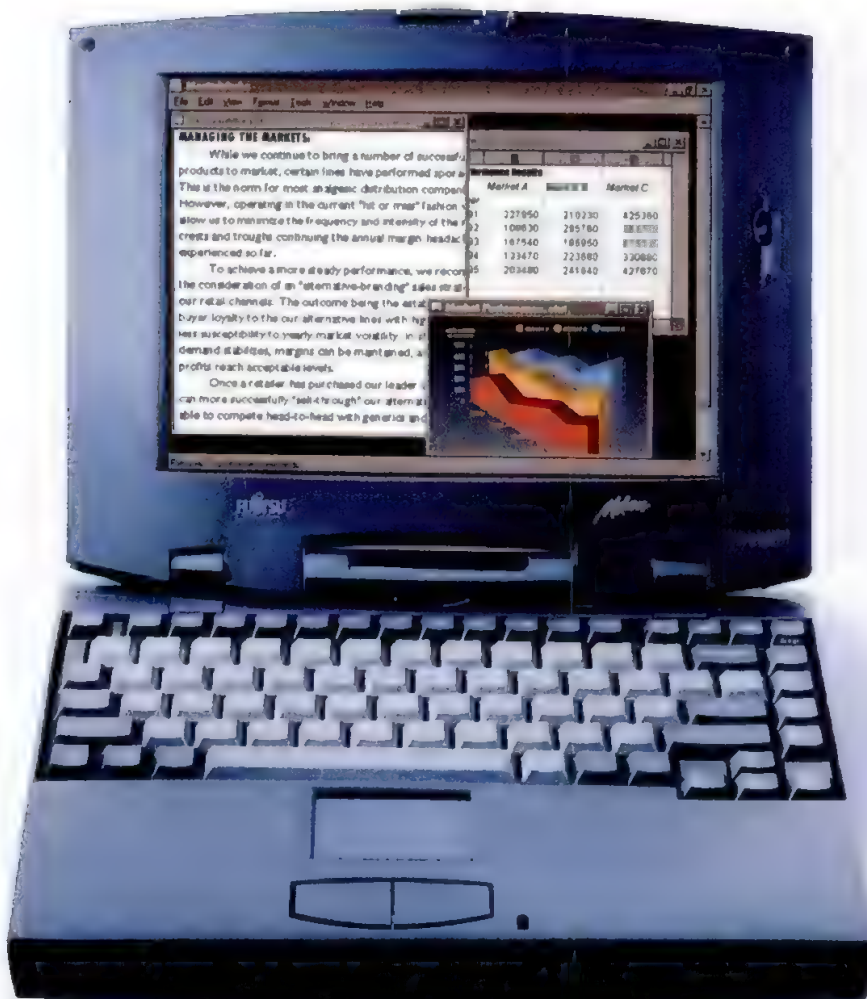
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provides up to 4.5 hours of battery
life to keep you going*



*On select models

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CIRCLE 224 ON READER SERVICE CARD

PC Support

Continued from page 52

a special section called The Human Side, featuring articles on Gateway's favorite technology-savvy people. Added amenities include a Help Desk, with special tech tips, and an area for kids called The Cow Zone.

IBM

Big Blue's Web site (www.ibm.com) reflects the company's present state of affairs: large, hard to define, and complex.

The site includes lots of information arranged in somewhat cumbersome lists complete with loads of hypertext links. Although the site offers little in the way of personalized technical support, it does provide several helpful features. IBMLink is a so-called planetwide search engine for locating IBM products and service abstracts, announcements, and related information. OrderLink allows you to obtain pricing information and order products online. Links to such other Internet resources as user groups and online publications are a helpful addition.

PACKARD BELL

Packard Bell has done a great job creating an easy-to-use site (www.packardbell.com) that touches on almost every service and support issue a user is likely to encounter.

There's a download library for finding drivers and other software files that ship with Packard Bell PCs, the ability to e-mail Packard Bell's technical support staff, a question-and-answer section addressing common computer problems, and upgrade information. There's also a complete alphabetical list of Packard Bell service centers. Information on Packard Bell's Premier support, a fee-based service providing software training for customers on a pay-as-you-go basis, is also available.

With extensive product information, technical support, and the latest drivers and other resources, the quality of vendor Web sites is quickly becoming a major buying consideration.

ONLINE DATABASES

Submit THIS! Creates Instant Online Databases

By Richard V. Dragan

Although it gets easier by the day to create and maintain simple Web pages, it's still a daunting task to create an integrated Web site with data gathering capabilities. Microrim's \$89.95 Submit THIS! 1.0 is an appealing entry-level product that can help beginners produce interactive Web sites that collect data for personal or small-business use. Submit THIS! starts with a clear and readable tutorial with a valuable section on Web terminology. Submit THIS! has modest system requirements and runs in Microsoft Windows 95 and Windows NT, and, by using the Win32s .DLL extensions, Windows 3.x.

Submit THIS! works with any browser, although we found that Netscape Navigator 2.0 and Mi-

crosoft Internet Explorer 2.0 worked best. Next, you need a file-transfer protocol (FTP) utility, an Internet Service Provider (ISP) for a domain name, and server space for your Web site.

Although almost anyone can design an appealing HTML page, there are hurdles to getting data that's been entered by Web surfers off the page and into the right place. Submit THIS! clears these hurdles with a library of 200 prebuilt HTML pages. There are personal and business home pages that require only a modicum of customization. On our tests, we quickly adapted sample pages for a small business-oriented Web site. Significantly, the content available in Submit THIS! includes links between pages.

The program also includes forms for data entry, with samples for product orders, job and membership applications, and requests for information. To promote the harmonized appearance lacking in most Web sites, each form is available in differ-

ent visual styles, including Standard, Jazzy, and something called Way Cool; you'll have to judge for yourself here. These forms make use of basic HTML types for input; there's no Java or ActiveX support included.

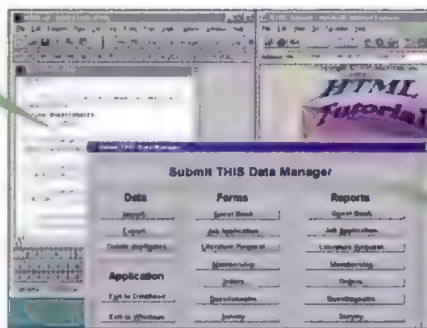
At the data collection end of the equation, Submit THIS! relies on standard Common Gateway Interface (CGI) scripting. Data is transferred from the Web page forms into your Web server with a minimum of fuss. There's plenty of documentation for both you and your ISP's Webmaster; it gives details for adapting these scripts to the specifics of your site. And Microrim includes free technical support specifically for your ISP.

Once your site is deployed and users start entering information on your HTML-based data

An able, but limited HTML editor allows you to add and change Web page tags.

Submit THIS! has online tutorials and pre-built pages to get you up to speed quickly.

The Data Manager is for importing and analyzing data entered by Web site visitors.



ALL IN ONE: A trio of tools in Submit THIS! simplifies dynamic Web design.

entry forms, the resulting data is placed in .CSV files on your Web server. You can then use an FTP utility to transfer these files to your PC. Submit THIS! comes with a stripped-down version of Microrim's R:BASE 5.5 for Windows, which is more than enough to manage the data at hand.

Submit THIS! has its own data management application for importing the .CSV files from the program's prepackaged forms. As long as we used the program's standard input forms, Submit THIS!'s Data Manager automatically imported our records without incident.

The biggest drawback of Sub-

mit THIS! is that it doesn't let you access live data from a database or a Web page. Nor is your Web site linked to your R:BASE database. That means that periodically you'll need to copy remote .CSV files locally.

Submit THIS! includes a shareware HTML editor called HTMLed 1.5. This tool allows you to add HTML tags using the program's toolbar buttons, which can be customized with your favorite tags. There is a personal-page wizard, but you may find that you can do better using a commercial HTML editor.

On the whole, Submit THIS!'s greatest strength is that it requires very little Web knowledge on the part of the user. It succeeds by delivering the basics for getting a data-centric Web site up and running quickly. Web experts will want to go elsewhere for more advanced Web authoring and database solutions.

At \$90, Submit THIS! is a less expensive than even a few hours with a Web consultant. Submit THIS! puts interactive Web site development into the hands of Web novices who want to use the Internet to collect information. **Submit THIS! 1.0.** List price: \$89.95. Requires: 8MB RAM, 10MB hard disk space, Microsoft Windows 3.x, Windows 95, or Windows NT, ISP or Web server, FTP utility, Web browser. Microrim Inc., Bellevue, WA; 800-628-6990; fax, 206-649-2785; www.microrim.com. Circle 417 on reader service card.

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DIGITAL CAMERAS

Making Movies Without a Blockbuster Budget

By Arie Moller, Daniel Grotta, and Sally Wiener Grotta

The emergence of inexpensive cameras has moved digital photography and especially the creation of video from the realm of the dedicated studio and editing suite to the desktop. Two filmless cameras, from Connectix and StarDot Technologies, lower the bar even further.

The Connectix Color QuickCam and WinCam.One each sell for about \$200 but offer differing levels of image quality, ease of use, and video quality.

CONNECTIX COLOR QUICKCAM

Two years after Connectix impressed the computing world with its inexpensive yet competent gray-scale QuickCam digital video camera (First Looks, January 8, 1995), the company follows up with the \$230 Color QuickCam. The QuickCam's golf-ball appearance and reliance on the PC's parallel port haven't changed, but this digital camera can capture upward of 24 frames of color video per second.

The key is a new data-compression algorithm called VIDEQ (Video Digitally Enhanced Compression), which uses a custom chip in the camera, to compress the video data stream from 4.6 megabits per second (Mbps) to 1.2 Mbps for a 16-bit color video clip at 160-by-120 resolution.

The camera includes two utilities: QuickPict for taking still pictures and QuickMovie for creating videos. During evaluation, we were able to consistently get 24 frame-per-second (fps), 16-bit video on a 133-MHz Pentium test system. At one-quarter VGA resolution, it was hard at times to discern image details. Although the camera's specification calls for at least a 486DX2/66 processor, we think you'll be disappointed with the results with anything less than a midrange Pentium PC.

We found that lighting was of

paramount importance in getting the most out of the Color QuickCam. The brightness level can be set automatically by the camera, but we recommend manual adjustment. Without manual adjustment, the Color QuickCam tended to set the brightness level too high, resulting in an overexposed and washed-out image.

When using the Color QuickCam, make sure that your display settings for color depth match those of the Color QuickCam. If not, you'll have to put up with annoying snakelike video artifacts.

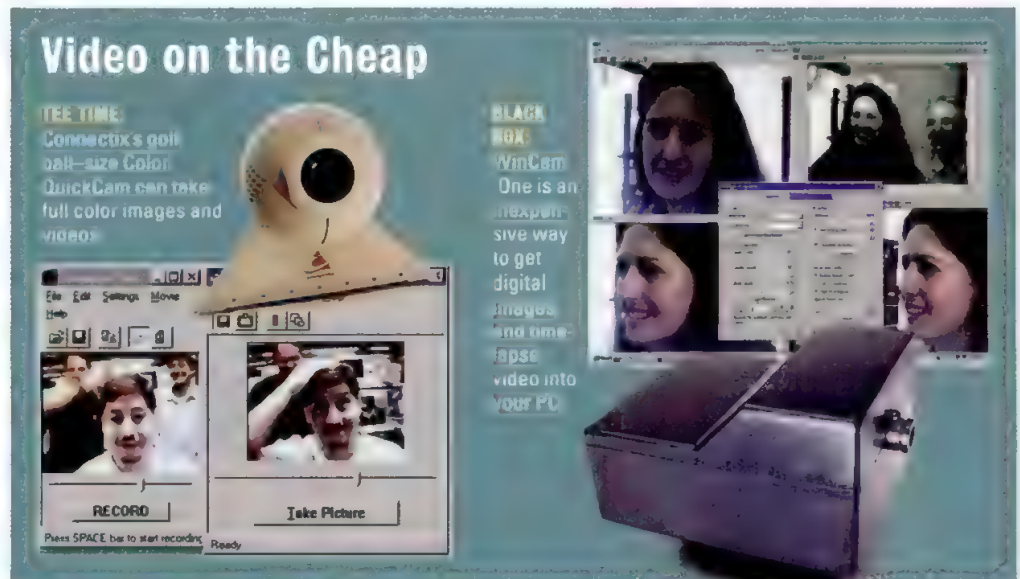
The Color QuickCam is an inexpensive solution for those want-

than four frames a second its video stream looks like a bad silent movie. But this versatile device gives users the ability to capture 640-by-480 resolution color pictures or produce time-lapse video clips inexpensively.

Packaged in a small black box, the WinCam.One is mounted on a flexible tabletop tripod. Like the Color QuickCam, it has no optical viewfinder, independent power supply, or memory storage. It is designed to remain connected to your PC's serial port, which allows the WinCam.One to be positioned as far as 250 feet from the computer.

time-lapse .AVI video file, although getting usable color images wasn't easy. The WinCam.One's charge-coupled device produced sharp pixels, but its limited dynamic range required a lot of light to get a fully exposed picture. One bonus is that the WinCam.One includes a slide adapter for digitizing transparencies.

WinCam.One's software has controls for automatic exposure and white balance, selecting the right light source, adjusting color balance, and reducing moire patterns. We were unable to improve image quality significantly though. In addition, the camera generated an annoying amount of noise, which resulted in randomly blotchy areas. WinCam.One was



ing to get rudimentary color video into the PC. With support from about a thousand developers, Connectix's little golf-ball camera has a bright and colorful future. **Connectix Color QuickCam.** Street price: \$230. Requires: 8MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. Connectix Corp., San Mateo, CA; 800-950-5880, 415-571-5100; www.connectix.com. **Circle 403 on reader service card.**

WINCAM.ONE

The \$200 WinCam.One camera from StarDot Technologies won't win any beauty contests, and at less

Setting up and using the WinCam.One was fairly easy though not foolproof. The camera's software automatically searched for the COM port and then made the connection. Unlike autofocus cameras, WinCam.One can capture everything from about 18 inches to infinity; you must loosen a set screw to focus to within 1 inch of the subject. In practice, the camera's low-resolution electronic view-finder made it difficult to focus accurately, and there are no reference marks on the lens to assist you.

A single mouse click can capture a .BMP image or start a

able to acquire standard- and high-resolution images in 20.5 and 43.3 seconds, respectively, although we couldn't see any difference between the two images.

Although WinCam.One's price is hard to beat, our choice in this market is the Connectix Color QuickCam.

WinCam.One. Street price: \$200. Requires: 4MB RAM, 5MB hard disk space, Microsoft Windows 3.1 or later. StarDot Technologies, Brea, CA; 888-782-7368, 714-528-9719; www.wincom.com. **Circle 404 on reader service card.**

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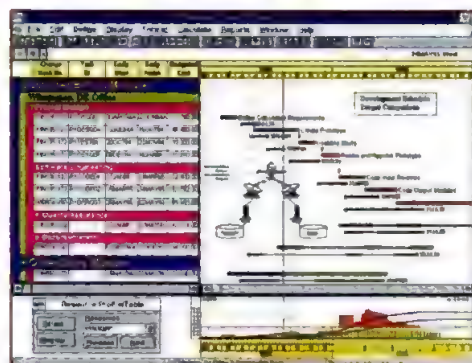
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MULTIMEDIA AUTHORIZING

Scala's MM100 Simplifies Multimedia

By Shane Mooney

Time was when if you had to create a multimedia presentation or program, it helped to be schooled in the finer points of machine-language esoterica. But after spending some time with Scala's \$250 MultiMedia MM100, you'll be programming with the best. This extremely easy-to-use program will do pretty much anything you can think of in terms of multimedia, even if you're C++-challenged.

MultiMedia MM100 can be described as an entire multimedia production studio rolled into one CD-ROM. Sure you can create presentations with it, but better yet, you can author presentations that incorporate full-motion video, music, and sound. Or you can develop a multimedia program or presentation using the tools to bring your information to life. You have access to a CD-ROM full of royalty-free clip art, sound effects, music, and MPEG videos. You can create a multimedia game or even an interactive cartoon using the Scala Toons Construction Set. Unlike with many of the production-type CDs we've seen, most of the stock multimedia files were of above-average quality.

But there's more to the program than just a collection of multimedia elements. Scala Wipes are excellent, video-like transitions that give your presentation a TV-quality look. Scala Type is a collection of unique, high-quality fonts designed specifically to look good on a computer screen. And Scala Sound lets you place multiple layers of sound, such as voice-overs, on top of music.

Behind the MultiMedia MM100 is an interface called Scala Human Touch, which we found to be fast and intuitive. All available options are described in plain language, and buttons are clearly marked. We were able to start producing professional material almost immediately by just following the buttons.

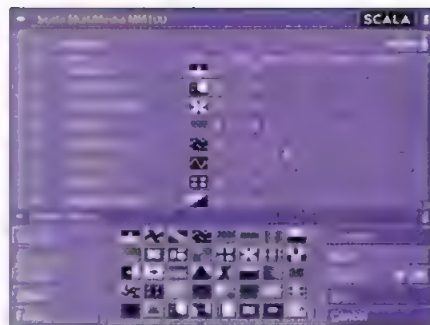
The program does, however, have its drawbacks. You can't build an executable file of the multimedia script you've created, so in order to view the production you must play it on a PC that has MultiMedia MM100 installed. And at times the program would insist that there wasn't enough room on our Microsoft Windows 95 machine (a test-bed with 16MB of RAM and a 1.2GB hard disk) for it to run. Also, under DOS the program locked up our system upon exiting.

These quirks aside, creating multimedia programs has never been as easy or as much fun. And it's all in a package that costs a fraction of what you'd normally pay for this kind of power.

MultiMedia MM100.

Street price: \$250.

Requires: 8MB RAM, 10MB hard disk space, Microsoft Windows 3.1, Windows 95, Windows NT, or OS/2 Warp.



MULTIMEDIA 101: MM100's Scala Human Touch interface makes creating polished multimedia presentations or programs a cinch.

Scala USA Inc., Herndon, VA; 800-947-2252, 703-713-0900; fax, 703-713-1960. Circle 405 on reader service card.

IMAGE EDITING

ColorWorks 2.0: Powerful Image Editing for OS/2

By Esther Schindler

Most graphics designers would likely dismiss OS/2 Warp applications with an indifferent shrug. But the new version of SPG's ColorWorks should change that reaction.

The \$179 ColorWorks 2.0 is a superb example of software that harnesses the power of OS/2, going far beyond drag-and-drop.

The graphics tools include everything you'd expect from such an application, including filters, special effects, warping and distortion tools, and photo retouching capabilities. You work with ColorWorks in one of two modes: painting and masks. ColorWorks extends the painting paradigm by enabling its tools to paint with several effects at once. It's as if you

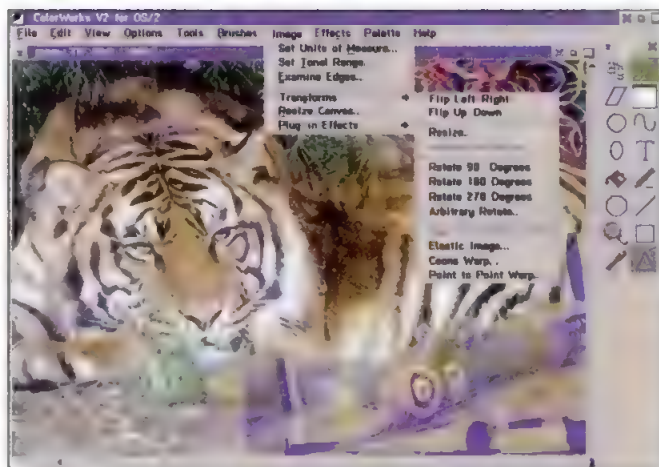
you create a combination of effects that you like, you can save it as a file for later use. You can apply a distortion, image, or protection mask to an image, then perform operations on it, from nonrectangular cropping to point-to-point warps. You control how images are merged using precise but understandable dialog boxes.

ColorWorks supports up to 255 levels of Undo, Pen for OS/2, enhanced Postscript printing controls, several options for managing color separations, and an interactive zoom. It's SMP-optimized; if you have a Pentium with multiple processors, you can tell ColorWorks how many of them to use.

With ColorWorks, you can work with large graphics in a compressed state. This puts a heavier load on the processor, but since your swap file doesn't grow, your work isn't constrained by hard disk speed.

ColorWorks isn't just an excellent OS/2 application, it's one of the best image processing software packages anywhere.

ColorWorks 2.0. List price: \$179. Requires: 8MB RAM, 15MB hard disk space, OS/2 Warp. SPG Inc., Miami Lakes, FL; 800-474-6672, 305-362-6602; www.spg-net.com. Circle 406 on reader service card.



COLLAGE: ColorWorks' powerful image masking and distortion tools make it simple to clone and merge graphics.

For instance, ColorWorks multi-tasks nearly everything; you don't have to wait for one effect to finish before you start another. You waste no time staring at an hourglass, while the minutes tick by.

had a palette on which you mixed not just colors but every graphics effect at your disposal. Instead of applying effects one at a time, you can apply smoothing, texture, and an 8-bit mask in one stroke. When

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GRAPHICS ACCELERATORS

A Trio of New 2-D Graphics Cards Push the Envelope, but 3-D Is on Its Way

By Jon Hill

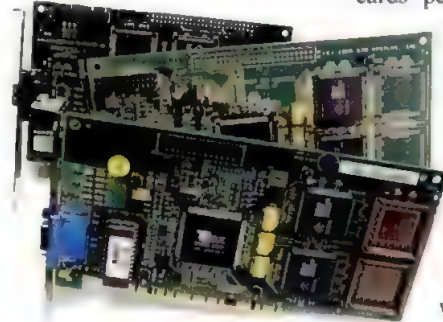
The latest 2-D graphics accelerators deliver stunning video and gaming performance at an affordable price, but they may be the last hurrah for 2-D graphics hardware. We tested three cards: Hercules's Dynamite 128 (\$230 street), STB Systems' LightSpeed 128 (\$200 street), and VideoLogic's GrafixStar 600 (\$180 street). Each delivered impressive video capabilities. They also showed exceptional gaming promise under Microsoft Windows 95 and flew through our graphics benchmark tests.

All three cards pair Tseng Labs' ET6000 accelerator chip with 2.25MB of MoSys's MDRAM (Multibank DRAM). Though the chip's memory pathway is technically 128 bits wide, a closer look reveals that it functions like two 64-bit paths, churning 128-bits of graphics data every two clock cycles. Technicalities aside, it's hard to argue with the results: ZD WinBench 96 and ZD Winstone 96 test scores on a par with the those of a comparably equipped Matrox Millennium, our most recent Editors' Choice high-end 2-D graphics card (See "3-D Comes Alive," June 25, 1996).

The ET6000 is compatible with standard DRAM chips, but the key to these products' performance edge is the use of MDRAM. MDRAM contains up to 32 separate banks, each with its own row and column structure. With up to 32 rows active, concurrent processes that repeatedly access the same memory areas can be serviced more quickly than with standard DRAM. The result is that such operations as screen refreshes, off-screen manipulations (important for video and DirectX games), and standard GDI services can often be executed simultaneously in graphics mem-

ory without causing significant decreases in performance.

With 2.25MB of memory, theoretically all three of these cards can support 24-bit color at 1,024-by-768 resolution, but none currently



AFFORDABLE ACCELERATION: With Tseng Labs ET6000 chip set and Multibank DRAM, these cards offer great performance.

offers this mode. Instead they top out at a resolution of 800-by-600 at this color depth but can display 1,280 by 1,024 pixels in 8-bit color. In 16-bit color mode, the LightSpeed 128 and GrafixStar 600 support a top resolution of 1,152-by-864, but the Dynamite 128 tops out at 1,024 by 768 pixels.

We tested each product on the

same test-bed as in our last graphics card story, running Windows 95, using ZD Winstone 96 to evaluate overall application-level performance and ZD WinBench 96 to exercise the hardware. All three cards performed exceptionally

well on our video playback tests; there were no audio breaks and negligible numbers of dropped frames at high data rates (up to 900K per second) at resolutions of up to 640 by 480 pixels. The ET6000's scaling engine, which uses bilinear interpolation in both the x and y directions, produces a scaled image that is noticeably smoother

than such single-direction interpolators as the S3 Trio64+ chip set.

The Dynamite 128 performed as well as or better than its two siblings and was competitive with the Matrox Millennium card on our Graphics WinMark 96 test with a score of 24.9 million pixels per second. But its ZD Winstone 96 scores were nearly 20 percent

lower than those of the LightSpeed 128 and GrafixStar 600, which effectively tied the Matrox Millennium on this test.

All three cards were equipped with DirectDraw drivers for Windows 95 and software MPEG video players: The Hercules and VideoLogic cards use Xing; the LightSpeed 128 offers MediaMatics Arcade. Each came with reasonably useful Windows 95 utilities and drivers for Windows 3.x, Windows NT 3.51, and OS/2.

Accelerator cards with 3-D support are already beginning to hit the streets. But in case you can't wait, these graphics accelerators offer top-notch video playback and 2-D graphics performance at very competitive prices.

Dynamite 128. Street price: \$230. Requires: PCI slot. Hercules Computer Technology, Fremont, CA; 800-532-0600, 510-623-6030; www.hercules.com. Circle 412 on reader service card.

LightSpeed 128. Street price: \$200. Requires: PCI slot. STB Systems Inc., Richardson, TX; 888-234-8750, 214-234-8750; www.stb.com. Circle 413 on reader service card.

GrafixStar 600. Street price: \$180. Requires: PCI slot. VideoLogic Inc., San Bruno, CA; 800-578-5644, 415-875-0606; fax, 415-875-4167. Circle 414 on reader service card.

BENCHMARK TESTS

128-Bit Graphics Accelerators



This trio of 128-bit graphics cards rivaled the Editors' Choice-winning Matrox Millennium ("3-D Comes Alive," June 25, 1996) for video playback and 2-D graphics performance. On our ZD Graphics WinMark 96 tests, the Hercules Graphics Dynamite 128 came closest to unseating the Millennium, with scores of 24.9 million pixels per second (800-by-600 resolution with 24-bit color) and 27.9 million (1,024-

by-768 with 16-bit color). On our ZD Winstone 96 tests, the other two cards, the STB Systems LightSpeed 128 and VideoLogic GrafixStar 600, excelled in both graphics modes.

To measure performance, we used ZD Winstone 96, Version 1.0, and ZD WinBench 96, Version 1.0. Each card was equipped with 2.25MB of Multibank DRAM and installed on a Pentium/133 PC with 32MB of EDO RAM, running Microsoft Windows 95.

Higher scores represent better performance.
Bold type denotes first place
among products reviewed

	ZD Graphics WinMark 96 (Millions of pixels per second)		ZD Winstone 96 (Score)	
	800 by 600, 24-bit color	1,024-by-768, 16-bit color	800 by 600, 24-bit color	1,024-by-768, 16-bit color
Hercules Graphics Dynamite 128	24.9	27.9	58	58
STB Systems LightSpeed 128	22.6	26.9	72	69
VideoLogic GrafixStar 600	22.7	26.5	73	70
Matrox Millennium (4MB WRAM)*	26.3	N/A	72	N/A

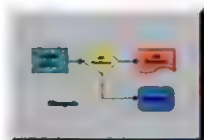
*Reported for comparison. N/A—Not applicable. The product was not tested at this resolution.



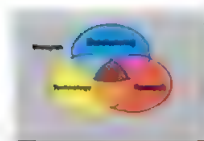
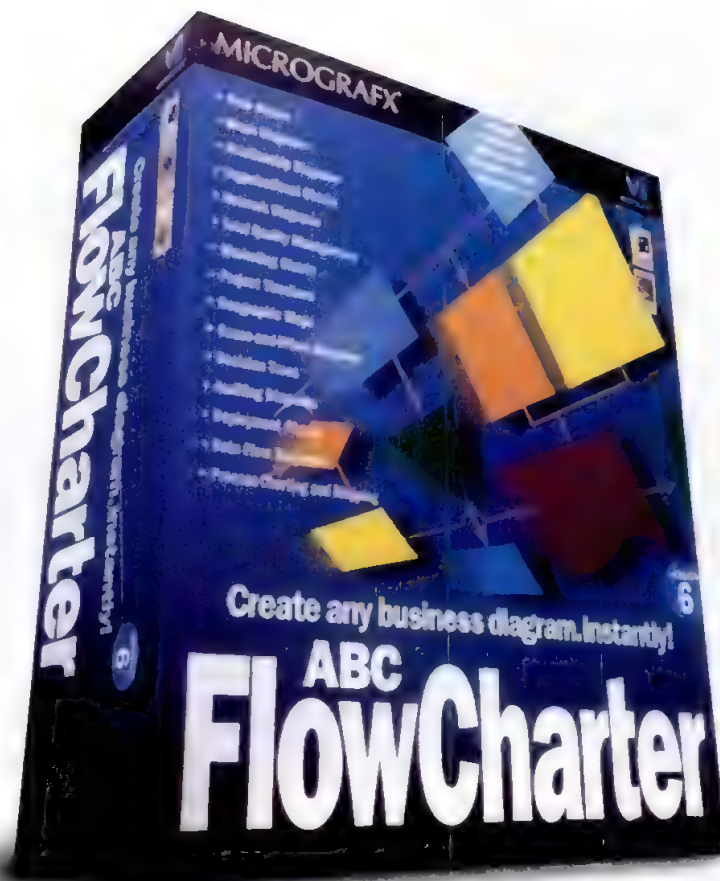
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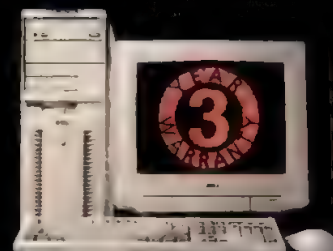
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AUDIO

Tower of Power: CrystaLake's Sound Card And Speaker Combo Rocks the House

By Bruce Brown

Sound-chip manufacturer CrystaLake Multimedia is making big news with its hot computer audio components. CrystaLake's \$230 Model 140 sound card and \$530 Model 650 speakers are big steps up from the components that ship with standard PC multimedia systems. For about \$750, you can have a computer system equipped with great tools for recording, creating, and listening to audio. In addition, you'll have a super system for gaming and speakers powerful enough to make you wish you'd invited the neighbors to join the party.

The CrystaLake Model 140 sound card is a 16-bit full-duplex, 4- to 48-kHz wavetable device. It features the company's Crystal CS9233 synthesizer, a CS8905 special-effects processor, and 4MB of ROM with 397 digital samples and 110 percussion sounds. FM synthesis features include 20 independent stereo voices with 4 FM operators.

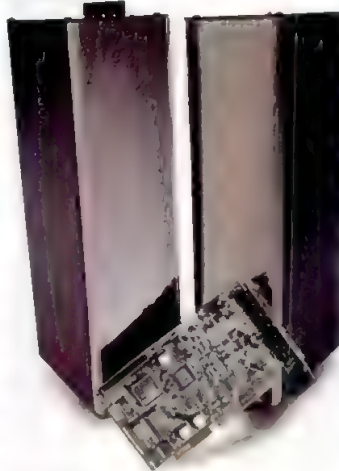
The Model 140 works with all major audio standards, including Ad Lib, MPU-401, Microsoft Windows Sound System, Roland GS, and Sound Blaster Pro 2.0. There's on-board SRS for space and center psychoacoustic effects, with an easy-to-use software control for width and center-range settings. Settings are predetermined for music and games, and you can save customized combinations of settings.

The Model 140's back panel has a joystick/MIDI port, two microphone inputs—one for each channel—and line-in and line-out jacks. CrystaLake conforms to the consumer audio standard of 2-Vrms (at 32 ohms) output gain, so the sound seems louder than normal even before it gets amplified by the speakers. The card also includes an IDE CD-ROM interface and a CD audio plug.

Software with the Model 140 includes drivers for DOS, Windows

3.x, and Windows 95, a five-channel mixer, a .WAV recorder, SRS controls, a Sound Forge .WAV editor, and MidiSoft's Recording Session MIDI file sequencer.

The Model 650 speakers are bigger than most computer speakers at 16 by 4.25 by 7 inches (HWD). The speakers have aluminum-colored cases and black grilles. The volume, balance, bass, and treble controls are on the top surface of the right speaker. There is no power switch; CrystaLake uses auto-start circuitry that goes into standby mode after 5 minutes with no audio signal. There are gold RCA stereo input jacks and a headphone jack that mutes the speakers when used.



DUET: Together, CrystaLake's Model 140 audio card and Model 650 speakers deliver booming, high-fidelity sound.

With a separate tweeter, woofer, and passive radiator in each speaker, the 50-Hz to 20-kHz Model 650 speakers produce an even sound throughout the audible frequency range. The result is clear high notes, steady vocals and other midrange audio, and strong bass response. When it comes time to crank it up, the Model 650 speakers can easily produce crowd-level sound with driving bass.

For most users the Model 140 card by itself will be enough to pump up the audio quality. But for discerning audiophiles, CrystaLake Multimedia's sound card and speaker set are worth the price. **CrystaLake Model 140.** Street price: \$230. Requires: 8MB RAM, 3MB hard disk space, Windows 3.x or Windows 95, ISA slot. **CrystaLake Model 650.** Street price: \$530. CrystaLake Multimedia Inc., Portland, OR; 503-222-2603; www.crystalake.com. Circle 411 on reader service card.

PRESENTATIONS

Corel Presentations 7 Puts Your Pitch on the Net

By David Haskin

Although Corel Presentations has lost the battle for market share to Microsoft PowerPoint, the \$99 Version 7 matches its competitor's presentation-creation skills and offers a whole variety of Web features.

title or thumbnail in that frame, a full-size version of the slide appears in another frame. You can create self-running Web presentations by designating how long you want a slide to appear on-screen.

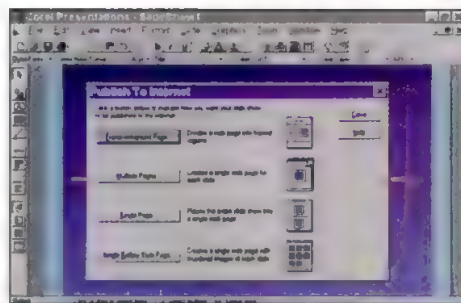
But Presentations is not a full-fledged authoring tool. Rather, it creates HTML pages containing .GIF or JPEG images of each slide, while links to URLs on the slides remain active.

In this upgrade, Presentations catches up with PowerPoint's support for animated bullet points. You

the steps of creating a presentation. You select a subject and your type of audience—friendly or skeptical, for example. PerfectExpert then creates a presentation with dummy text and graphics that you replace with your own.

Presentations also shares one of its competitors' biggest shortcomings: It isn't very adept with multimedia; you have to embed videos and animations into slides as OLE objects. Another downside to Presentations is that you must dedicate at least 30MB of your hard disk to the program because the standalone version still requires installation of code shared by applications in Corel WordPerfect Suite 7 and Corel Office Professional.

Nevertheless, you'll find Corel Presentations 7 to be feature-rich, easy to use, and inexpensive. **Corel Presentations 7.** List price: \$99. Requires: 8MB RAM, 30MB hard disk space, Microsoft Windows 95. Corel Corp., Ottawa, Ontario, Canada; 800-772-6735, 613-728-3733; www.corel.com. Circle 410 on reader service card.



CYBER PRESENTATIONS: To create Web presentations, simply follow the wizardlike dialog boxes.

With Corel Presentations 7, you can create Web-based presentations using the program's wizard-like series of dialog boxes without having to hand-code HTML. You can even create frames-based Web presentations that list all slides in one frame. If you click on a slide

select the path you want the bullet to take or insert a transition effect for each bullet, such as a fade or sparkle. These effects don't work with Web presentations.

Like PowerPoint, Presentations has excellent task automation. Its PerfectExpert walks you through

IT'S ONLY LOGICAL THAT INTELLIGENT MANAGEABILITY (NOW, WHAT THE HECK IS IN



Intelligent
Manageability is kind
of like Extra Sensory

Perception for a computer and every new Compaq Deskpro has it. It lets you know if something's going to happen before it actually does. This way you can manage all of the desktops on your network from one location.

Taking inventory, for instance, of all hardware and software is done simply and efficiently from one Deskpro. Or if a hard drive's about to fail anywhere, you'll know ahead of time. As before, Intelligent Manageability backs up

your data on the network in case of failure; but now, thanks to our new PD-CD drive backup, it also preserves your data locally.

Okay, so our newest version of Intelligent Manageability is smart. But affordable? Considering that the Deskpro line from Compaq starts at around \$1,100*, we think so.

Equally impressive are the high-performance features. Up to Pentium® Pro 200 processors. Choice of PCI graphics. Plus a choice of EIDE and Ultra SCSI hard drives.**

And maintenance? That's easy

*I'm burnt.
I need a vacation.*



because we deliver continually updated support software via our Web site and CDs. And so is upgrading and servicing, thanks to a quick-release CPU hood and accessible components.**

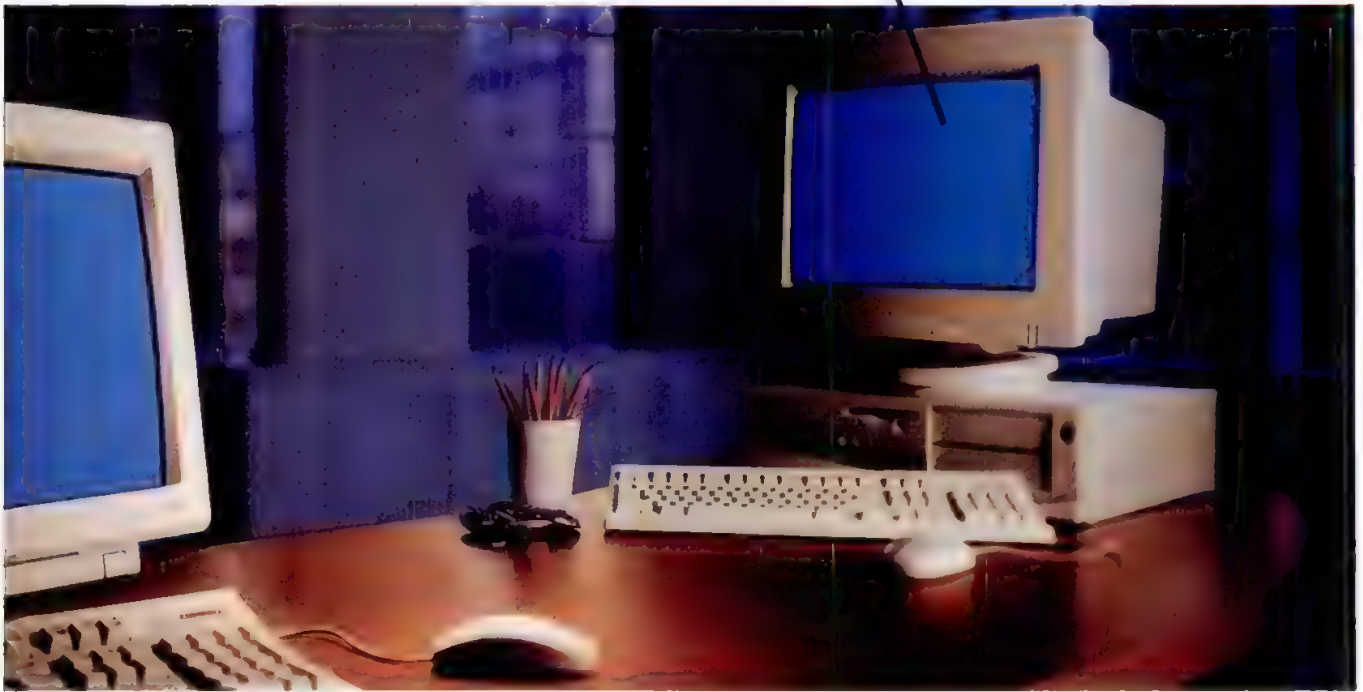
In the end, Intelligent Manageability gives you a lowered cost of



©1996 Compaq Computer Corporation. All rights reserved. Compaq and Deskpro registered U.S. Patent and Trademark Office. Deskpro is covered by our 3-year limited warranty. *Price mentioned is estimated street price, with Windows 95. The Intel Inside Logo and Pentium are registered trademarks and the Pentium Processor Logo and the Pentium Pro Processor Logo are trademarks of Intel Corporation. Other products mentioned may be trademarks of their respective owners.

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INTELLIGENT MANAGEABILITY?)

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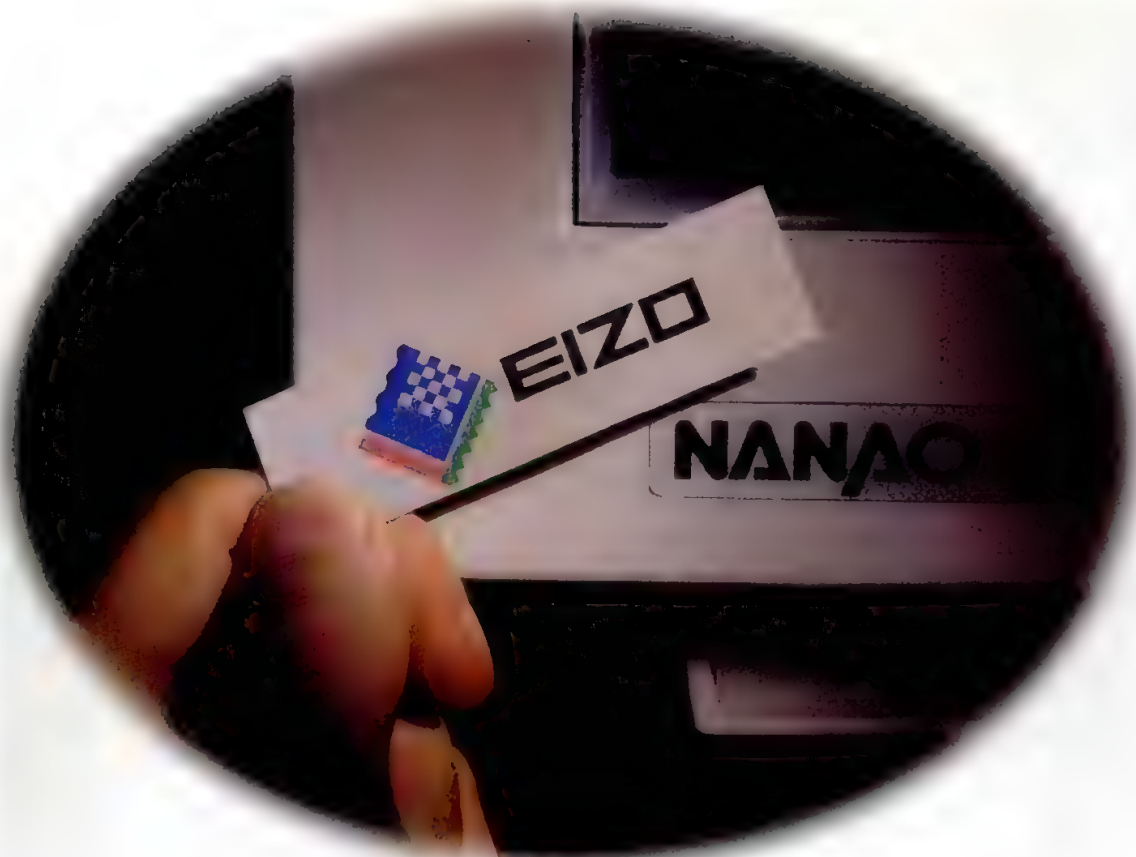
*The Deskpro line
starts at around
\$1,100**



COMPAQ

Has It Changed Your Life Yet?

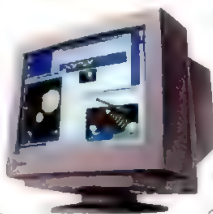
Dealer prices may vary. *Features vary by model. Monitor not included. Thermal sensor available only on Deskpro 4000 and 6000. Some features available with Compaq Deskpro and independent software applications. Other features only available trademarks or registered trademarks of their respective companies.



Underneath it all, we're still the same.

You may not know the name, but you'll surely recognize the face. Beginning with models launched in April, "EIZO" will become the brand name on every new Nanao monitor added to our line.

Each one will carry on the legacy of quality, innovation and performance synonymous with Nanao. In fact, the only difference you'll see is the name on the front of the bezel and the innovations that consistently put us far ahead of our competition.



EIZO monitors will continue to be developed and manufactured by Nanao. You can count on the same leading edge technology, advanced performance and superb construction you've come to expect under the Nanao brand name.

For years, Nanao monitors under the EIZO brand name have been the leading choice of discriminating corporate business users in Europe. You'll soon ask for them by the same name in the U.S.

As you can see, the more things change, the more they stay the same.



NANAQ

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Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

By Brian Nadel

UTILITIES

Update Your PC at the Touch of a Finger

WITH PROGRAM UPDATES and bug fixes falling out of the sky faster than autumn leaves, keeping your PC in top form can seem like a full-time occupation. Cybermedia's First Aid 95 Deluxe (Second Looks, June 25, 1996) can refresh your PC by updating Microsoft Windows 95, but what about your applications?

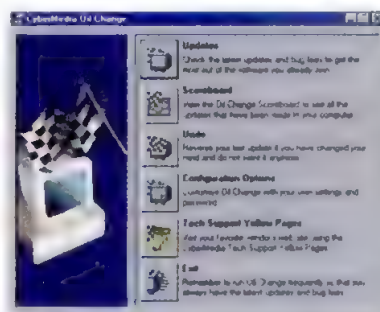
Enter Oil Change, from Cybermedia, an innovative utility that provides near-instantaneous program updates. Click on the Up-

dates icon in Oil Change and it scans your system to find out what software you have installed, logs on to Cybermedia's Web site, recommends any updates that are available, and then transports those you choose directly to your PC. In some cases, the updates are automatically loaded, for others you need to install them manually.

The beta version of Oil Change that we downloaded from Cybermedia's Web site (www.cybermedia.com) worked well, and we found ourselves frequently logging on just to see if anything new was available; a retail version will cost about \$50 and should be on store shelves by fall. With Oil Change, we were able to update the drivers for our Creative Labs Sound Blaster audio card as well as Oil Change itself. The program avoids potential damage by keeping a detailed log of activities and providing an Undo button.

Another approach comes from Cirrus Arts' Versions, an e-mail-based system run from a Web site (www.versions.com). This free

service covers over 23,000 programs from such vendors as Apple, Lotus, Microsoft, and Symantec. Working with Versions is more labor-intensive than using Oil Change. First you must decide



which applications you want to be on your TrakList database of monitored programs. This is a time-consuming and tedious task, because you can't group similar programs. For example, each of the 13 Adobe Capture programs had to be added individually to the TrakList.

Versions then sends you an e-mail message with details about updates for those items on your

TrakList. Once you hear about an update that you can't live without, you connect with the publisher's Web site, FTP site, or BBS to get it. Versions is working on a way to scan your system, automatically fill in the TrakList, and deliver the files to your PC.

Versions took a while to get started, because the site is still under construction and has concentrated on Macintosh applications. But we soon were getting e-mail notices of upgrades and fixes for Fractal Design, FormFlow, and other programs. The program is good and reasonably up-to-date, but some corporate users who

connect to the Internet via a network firewall may not be able to establish an account and will need to use a dial-up connection.

Rather than being competitors, Oil Change and Versions are complementary, and at the risk of advocating wearing a belt and suspenders, we recommend both tools as part of your PC's preventive maintenance regimen.

BUG BRIEFS

PROBLEM

Some Apple PowerBook 5300s have a tendency to freeze up or change their color palettes suddenly.

SOLUTION

Apple is recalling several batches of these Macintosh notebooks. If you think your system is defective, call Apple at 800-767-2775, or go to an Apple distributor.

PROBLEM:

A back-end credit card glitch resulted in some users of Intuit's TurboTax being charged twice for the \$14.95 electronic income tax filing fee.

SOLUTION:

If you've been double-billed, call Intuit at 800-826-7567 and they'll arrange either to send you a refund check or credit your account.

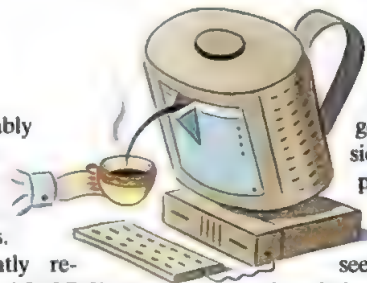
WEB PROGRAMMING

Instant Brew for Café

WHEN WE REVIEWED SYMANTEC Corp.'s Café 1.0, a Java development environment, we were impressed with the program's ability to put a more visually appealing and functional face on Java (First Looks, June 11, 1996). The missing element was support for Symantec's just-in-time (JIT) Java Compiler,

which noticeably speeds up the execution of Web-based Java applets.

The recently released Version 1.2 of Café not only adds the JIT compiler, but it also improves the program's debugging capabilities by adding the



ability to perform exception handling. Together, these revisions can help to produce a stronger brew for Web heads seeking a caffeine fix

for their sites. You can download these Café updates free from Symantec's Web site (www.symantec.com).

LOOKING AHEAD

Tell us what you love and hate about these products and we'll share the information in future issues. Color ink jet printers • CD-ROM encyclopedias • Cyrix

PCs • EZ SCSI 4.0 • Lotus Notes Release 4 • Microsoft Internet Explorer • Netscape Navigator • Pentium Pro PCs • RealAudio • SoftWindows • Windows 95 utili-

ties. Contact Brian Nadel directly via MCI Mail (556-1500) or CompuServe (72241,1616), or on the Internet at BNadel@zd.com.

THE HOME THEATER YOU CAN TAKE ON THE ROAD.



THE 700 SERIES NOTEBOOKS

Talk about putting on a show. The new 700 Series notebooks from CTX offer you more multimedia features and a higher level of audio and video performance than have ever before been offered on most notebooks.

Just look at the display screen. It's 12.1 inches in diameter, as big as some desktop models, and supports 64,000 vibrant colors at a resolution of 800 x 600.

Notice also the advanced video features. With NTSC jacks, MPEG-1 capability, 1.5MB video memory, and a PCI Video Bus with GUI accelerator, you couldn't ask for a better computer for roadshow presentations.

Quite simply, if you're looking for exceptional multimedia power, performance and value, you won't find a better choice than one of the 700 Series notebooks from CTX.

For more information
call 1-800-888-9052.

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12.1" active or passive matrix LCD gives you desktop display capability with 800 x 600 resolution.



128-bit graphics controller with integrated memory and PCI Video Bus with GUI accelerator deliver faster, sharper MPEG-1 video playback of clip files and graphics-intensive applications



NTSC jack allows direct connection to a standard television for multimedia presentations.



Intel Pentium® 100, 120, or 133 MHz processor gives you the power and speed you need to perform the most complex multimedia tasks.



Removable internal six-speed CD-ROM drive comes with Microsoft Works, Encarta, Money, Bob, Scene, Entertainment Pack, Microsoft Plus and Windows '95 value pack.



New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Melissa J. Perenson

Online Services Get a Facelift

COMPUSERVE INFORMATION Service, the nation's second largest online service, has finally released the long-—and eagerly—awaited **CompuServe 3.0**.

The 32-bit software builds on the fundamentals established by CompuServe's WinCIM front end and adds new features and functionality. Extensive cosmetic enhancements boost user-friendliness and navigation of the interface. Key to this version is integration of INSO's text and file viewer, inclusion of a customized version of Netscape Navigator 2.02, servicewide batch-file downloads, and a user-customizable Home Desktop and Toolbar. Also improved

is the stability of the file cabinet.

Meanwhile, **Dow Jones Business Information Services**, which is the business user's online service, has upgraded its interface and changed its pricing structure so that charges are rendered on a per-transaction basis.



CompuServe Inc., Columbus, OH; 800-254-3388, 614-457-8600; www.compuserve.com. Circle 420 on reader service card.

Dow Jones & Co. Inc., Princeton, NJ; 800-369-7466; bis.dowjones.com. Circle 421 on reader service card.

Presenter Plus

SOME SCAN CONVERTERS take pride in their compact size. Others, like AVerMedia's **AVerKey 5**, find strength in a robust feature set. The \$599 PC/Mac-to-TV scan converter supports 24-bit SVGA at up to 800-by-600 resolution with 16.7 million colors. The remote control provides access both to the scan converter's controls and mouse functionality. The controls are also inte-

grated into the unit's control panel. In addition, the AVerKey 5 features three types of zoom and pan functions

AVerMedia Inc., Fremont, CA; 510-770-9899; fax, 510-770-9901; www.aver.com/aver. Circle 422 on reader service card.



PHOTOGRAPH BY THOM O'CONNOR

A Notebook in Sharp Focus

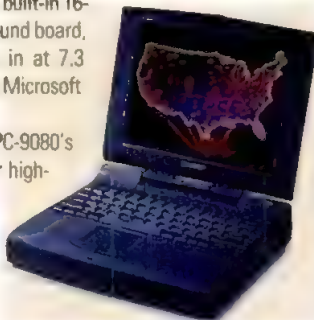
Sharp Electronics Corp. has upped the ante for what should be considered standard equipment on a high-end multimedia notebook. Of course, high-end comes at a price: The **Sharp PC-9080** will cost you about \$6,000.

One of the notable things about the PC-9080 is its high-resolution, XGA screen, which shows crisp images at 1024-by-768 on a roomy, 12.1-inch active-matrix display. According to Sharp, the display uses the company's proprietary Super High Aperture technology to make the screen 50% brighter than other LCD screens.

A PCI-based system, the PC-9080 comes standard with a 133-MHz Pentium processor, a 1.3GB hard disk, 16MB of EDO RAM, and a modular 6X CD-ROM drive. The system also features an internal 28.8-Kbps fax modem, a modular 3.5-inch floppy drive that can be swapped with a second lithium ion battery, 256K of L2 cache, MPEG-1 software, a built-in 16-bit Sound Blaster Pro-compatible sound board, and an internal adapter. Weighing in at 7.3 pounds, the PC-9080 is compliant with Microsoft Windows NT.

Another highlight of the unit: The PC-9080's IrDA port utilizes 4-Mbps infrared for high-speed wireless transmissions.

Sharp Electronics Corp., Mahwah, NJ; 800-237-4277, 201-529-8200; www.sharp.com. Circle 432 on reader service card.



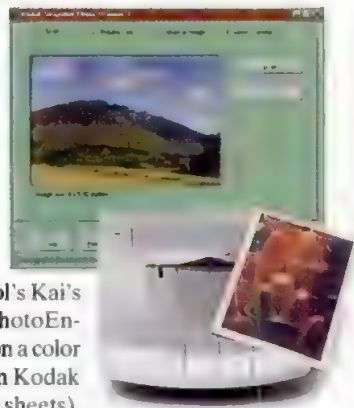
For Those Golden Moments

IT WAS ONLY A MATTER OF TIME BEFORE KODAK JOINED the photo scanner party. At just \$199, the **Kodak Digital Science Snapshot Photo Scanner** enters the market with a splash.

The sleek scanner, which was designed by Kodak, accommodates photos of all sizes and thickness, including trading cards, Advanced Photo System prints, and standard prints of up to 4 by 11.5 inches. The Twain-compliant device lets you capture images in 24-bit color at resolutions of up to 600 dots per inch.

Once you've played with your image using any of the included software packages—Storm's EasyPhoto image editor, MetaTool's Kai's Power Goo, and PictureWorks' PhotoEnhancer—you can print your image on a color inkjet printer using the 4- by 6-inch Kodak Snapshot Inkjet Paper (\$10 for 36 sheets). Or you can send your image via e-mail using Kodak's Picture Postcard Software (available on the Web).

Eastman Kodak Co., Rochester, NY; 800-235-6325; www.kodak.com. Circle 418 on reader service card.



HOT PROSPECT

Crystal Sound

FOR A TRUE CLINIC IN WAVE-table sound quality, look at Crystal Computer Corp.'s \$299.95



Crystalizer TidalWave32

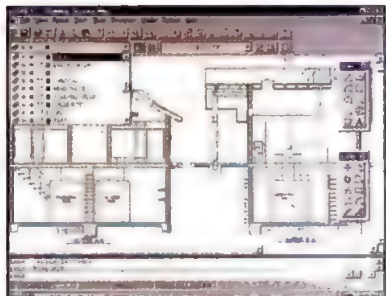
PnP. The card features the 32-voice Polyphony OmniWave Stereo Synthesizer (which is compatible with Roland Sound Canvas GS, General MIDI, and Sound Blaster). The jumperless card also has 2MB of MROM, which stores all 128 General MIDI sounds, 128 MT-32 sounds, and more.

Crystal Computer Corp., San Jose, CA; 408-383-2100; fax, 408-383-2110. Circle 419 on reader service card.

Drawing for the Experts

CAD SOFTWARE STEPS UP TO THE PLATE WITH THREE new 32-bit packages.

Leading the charge is Autodesk's \$490 **AutoCAD LT for Windows 95 and Windows NT**. This popular 2-D design and drafting software



offers complete interoperability with AutoCAD Release 13 and includes template tools for getting started on drawings quickly. Other productivity enhancements include a real-time pan and zoom, a property painter, and advanced geometrical design.

Based on American Small Business Corp.'s DesignCAD 3D, Corel Corp.'s \$585 **CorelCAD** takes that package several steps further. CorelCAD is a 3-D modeling and 2-D drafting package with a customizable interface and industry-standard ACIS solid modeling. There's also support for Boolean operations, the calculation of engineering properties, MAPI, scripting, and the conversion of surface models to solids.

A longtime leader in the Macintosh CAD market, Diehl Graphsoft goes cross-platform with its 32-bit **MiniCad 6 for Windows**. This \$795 3-D modeling and 2-D drafting package is packed with functionality. An unusual feature lets you create 2-D and 3-D drawings simultaneously, while MiniCad's SmartCursor helps you create precise 2-D designs by identifying relevant parallels, intersections, snaps, and tangents as you draw. There's an integrated database and spreadsheet for tracking project costs and materials, macro programming, and a Design and Drafting Toolkit, which features an impressive library of over 10,000 industry-specific resources for architects, mechanical engineers, and other design professionals.

Autodesk Inc., San Rafael, CA; 800-228-3601, 415-507-5000; www.autodesk.com. Circle 423 on reader service card.

Corel Corp., Ottawa, Ontario, Canada; 800-772-6735, 613-728-8200; www.corel.com. Circle 410 on reader service card.

Diehl Graphsoft Inc., Columbia, MD; 410-290-5114; fax, 410-290-8050; www.graphsoft.com. Circle 424 on reader service card.

Optimum UPS

VIEWSONIC CORP., WHICH IS known for its monitors, also manufactures a line of plug-and-play uninterruptible power supplies (UPSs). Each model in the **Opti-UPS** line—the \$139 **280E**, the \$199 **420E**, the \$319 **650E**, the \$489 **1000E**, the \$599 **1400E**—features a built-in line conditioner, brownout regulation, a hot-swappable battery, and

\$25,000 of surge-protection insurance. Each also comes with ViewSonic's intelligent Power Management Software Suite, which monitors your power supply and in the event of a power failure backs up your data and closes open files. An SNMP network adapter is available for \$299.

ViewSonic Corp., Walnut, CA; 800-843-6784, 909-869-7976; fax, 909-468-3756. Circle 425 on reader service card.

Storage Alternatives

EXPERIENCING A CRUNCH IN STORAGE SPACE? HERE ARE two very different external approaches to the storage problem.

Micro Solutions, which is known for its mass-storage parallel-port products, is offering the **backpack pd/cd**. Priced at \$599, this parallel-port PD/CD drive offers up to 650MB of storage per removable/rewritable optical cartridge. The device supports EPP and IEEE 1284 ports, and LPT1, LPT2, and LPT3 ports; a printer pass-through port is also included. For an introductory period, a PD cartridge is included with the drive.

Upping the ante on its previous EZ135 drive, SyQuest Technology is now offering the \$299 **EZFlier 230**. Like the EZ135, the EZFlier is based



on removable hard disk technology and is available in external parallel-port and SCSI configurations. The drive features an average access time of 13.5 milliseconds and a burst-data-transfer rate of up to 4MB per second. Additional 3.5-inch cartridges cost \$29.95 apiece. The drive is backward compatible with the EZ135.

Micro Solutions Inc., DeKalb, IL; 800-890-7227, ext. 200, 815-756-3411; fax, 815-756-2928. Circle 426 on reader service card.

SyQuest Technology Inc., Fremont, CA; 800-245-2278, 510-226-4000; www.syquest.com. Circle 427 on reader service card.

BRIEFS

Books

Microsoft FrontPage is a WYSIWYG editor that can make novices look like Web masters. Two new books, **Web Publishing with Microsoft FrontPage**, by Martin S. Matthews, (\$27.95, Osborne McGraw-Hill, 800-227-0900) and **Introducing Microsoft FrontPage**, by Kerry A. Lehto and Brett Polonsky (\$24.95, Microsoft Press, 800-877-7377) show you how to use FrontPage The Web has leveled the playing field for entrepreneurs and small-business owners. Learn how to develop an online commerce strategy and set up a

Web site for your business with **Build a World Wide Web Commerce Center**, by net.Genesis (\$29.95, Wiley & Sons, 800-225-5945) History of the Net, Part I. **Where Wizards Stay Up Late: The Origins of the Internet** is the behind-the-scenes story of the engineers who invented the Net (\$24, Simon & Schuster, 800-323-7445).

Upgrades

Time to bring your notebook up to speed? A host of upgrade solutions are available, including: **Portable Enhancements' AMD**

5x86 CPU upgrade for Compaq, IBM, Texas Instruments, and Toshiba laptops. Priced from \$399 to \$499, this processor boost will take your 486SX/33 processor up to about the equivalent of a Pentium 75-MHz (800-737-7693) Also offering a CPU upgrade is **Gainberry Computer Products**, whose **586 upgrade** is available for both desktop and notebook PCs; various options are available, including one for a 486-to-Pentium upgrade, another for a Pentium/60 or -/66-to-Pentium/100 or -/166 upgrade, and a third for upgrading a Pentium/75, -/90, or -/100. Prices



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\$3399
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- 1GB REMOVABLE HARD DRIVE
- 28.8 SEND/RECEIVE FAX/DATA MODEM
- 11.3" TFT ACTIVE MATRIX DISPLAY

\$3599
FX 133MHZ

- 133MHZ INTEL® PENTIUM® PROCESSOR, POWER SAVING NOTEBOOK CHIP
- 16MB EDO RAM
- 1GB REMOVABLE HARD DRIVE
- 28.8 SEND/RECEIVE FAX/DATA MODEM
- 11.3" TFT ACTIVE MATRIX DISPLAY

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- Flash BIOS for easy upgrade
- Designed for Windows® 95
- Preloaded HP DMI Desktop Management Interface
- Free three-year limited warranty for parts and labor¹

from **\$1,262***



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Best managed PC.

- Intel 75, 100, 120, 133, 150 or 166 MHz Pentium processor
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- Preloaded HP DMI Desktop Management Interface
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- 4 mass storage shelves (3 front accessible), 4 expansion slots
- Two 32-bit PCI slots
- Flash BIOS for easy upgrade
- Designed for Windows 95
- Free three-year limited warranty for parts and labor¹

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- 8-16MB RAM, expandable to 128MB
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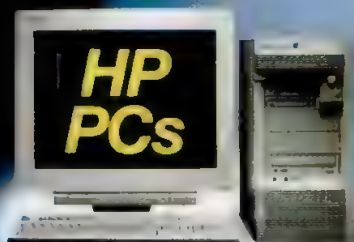
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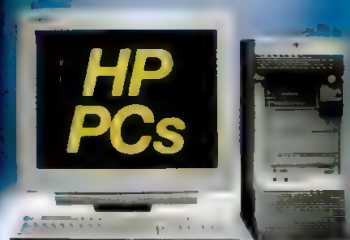
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Ulead Systems Inc., Torrance, CA; 800-858-5323, 310-523-9393; www.ulead.com. *Circle 430 on reader service card.*



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MicroHelp Inc., Marietta, GA; 800-777-3322, 770-516-0899; www.microhelp.com. *Circle 428 on reader service card.*

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SYMANTEC CORP. TAKES ITS latest version of the 32-bit **pcAnywhere32** online. Now in Version 7.5, the \$150 pcAnywhere lets you remotely control another computer or transfer files over the Inter-

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Presario 6000 series, which is offered in the same desktop and mini-tower configurations as the 4000 series, offers such options as a 33.6-Kbps DSVD modem, Compaq's Scanner Keyboard, and enhanced voice mail software.

For the true multimedia and gaming aficionado, the **Presario 8000 series** of mini-tower PCs is packed with features. Compaq uses the PowerVR 3-D graphics card super-accelerator for smooth, arcade-quality graphics and includes the ThrustMaster Advanced Gamepad for maneuvering through games. The sound system includes InterWave 32-voice wavetable sound and an optional JBL Pro subwoofer. The 8000 series includes 32MB of RAM, a 2.5GB hard disk, 8X CD-ROM drive, 512K pipeline-burst cache, and 6MB of graphics memory.

Compaq Computer Corp., Houston, TX; 800-345-1518, 713-514-0484; www.compaq.com. *Circle 431 on reader service card.*

BRIEFS

range from \$139 to \$899 (800-825-7331) Owners of the Toshiba Tecra series of notebook PCs can improve their storage capacities through **Laptop Solutions'** 1.3GB and 2.1GB removable hard disks, priced at \$945 and \$1,195, respectively Expand your IBM ThinkPad 760E series notebook's memory with **Apricorn's** 64MB DIMM carrier, which allows you to take your ThinkPad's RAM up to a total of 104MB (619-271-4880) **MGV Memory's** memory modules upgrade the ThinkPad 560, 760E, and 365X; prices for these 64-bit EDO RAM mod-

ules start at \$1,299 (800-440-4648) And finally, owners of **Texas Instruments'** Travel-Mate 6000 systems can expand their horizons with such add-ons as a 1.2GB hard disk, a 6X CD-ROM, and 6MB of EDO RAM; prices start at \$649 and go up to \$1,299 (800-848-3927).

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CIRCLE 208 ON READER SERVICE CARD

A PDA for Musicians

It had to happen. With the plethora of personal digital assistants for businesspeople, it was just a matter of time before someone came out with one tailored to the unique needs of musicians. No, it's not preprogrammed to schedule lunch with your manager or

trash hotel rooms. It's the PMA-5, an electronic musical instrument the size of a paperback book that's made by Roland, a leading producer of electronic keyboards, MIDI processors, and effects boxes.

The PMA-5 boasts a touch screen, which you can use with the built-in stylus or with your finger. You can call up any of over 300 instrumental sounds, many of them prearranged into 100 different musical styles, from Dixieland and ragtime to smooth beguines and sambas to hard-edged rock and funk sounds. You can overlay chord progressions and choose among half a dozen substyles to produce instant accompaniment from, say, rhythm guitar, keyboard, bass, and drums. You can even use an "oldies" substyle, featuring background singers crooning "doot-doot." The PMA-5's four-track sequencer lets you add your own leads and melodies, too.

Roland touts the PMA-5's interface as "intuitive," but one person's intuitive is another's idiosyncratic. I found it a bit unusual but workable once I stopped trying to force it to work the way I wanted it to. After I experimented with building a few accompaniments, the interface was no longer a hindrance.

Of course, someone's going to complain, "Gadgets like this put musicians out of work." No, they save relationships. I can't think of a single band in which everyone wanted to play the same thing at the same time. Singers need to rehearse lyrics and learn new songs, guitarists want to try out new lead solos, and so on. The PMA-5 is the ideal rehearsal partner. No matter how many times you want to play "Layla," it's there for you, willing to change key or tempo at your whim.

Let's say you're a guitarist trying to work out a tricky dialogue with the keyboard player. Using a MIDI keyboard, he can load his riff into the PMA-5 and you can play it again and again until you get it right. If you're a solo musician, the PMA-5 can indeed be your backup band, but there's a limit to the number of venues willing to accept electronic accompaniments in place of the real thing.

The sound quality is superb, right up there with that of

Roland's renowned Sound Canvas. Some of the rock styles, though, are too dependent on pitch bend for my taste. They have an out-of-tune feel reminiscent of the early Rolling Stones. But then, who listens that closely to rock-and-roll backup arrangements? The PMA-5 will drive headphones

when you're on the road, but it needs an amplifier and speakers for performances. It also sucks down batteries as if they were free. You'll only get 5 or 6 hours out of its half a dozen AA alkaline batteries, and the AC adapter costs extra. To conserve power, there's no backlight on the touch screen, so it can be hard to read in some lighting conditions. If you take the PMA-5 to your rehearsal in a dimly lit club, you'll need to bring along a book light to locate its more detailed settings, but it's easy to find the play, stop, and selection buttons.

Every PDA worthy of the name can exchange data with a PC, and the PMA-5 is no exception. An accessory kit provides a cable and software to move MIDI files back and forth, so you can use powerful sequencers to arrange your music or download MIDI files to your PMA-5.

Of course, if you don't need portability, you don't need a PMA-5. PC-based sequencer software, such as Cakewalk, is significantly more capable. Programs such as Band in a Box offer the same flexible options for automatically arranging backups and melodies, and any sound card with wavetable synthesis can provide acceptable sound quality. Indeed, a PC can go considerably further, offering multitrack digital recording and sound editing—in effect, a complete recording studio. You can even equip a notebook with a PC Card MIDI adapter or a synthesizer such as Roland's SCP-55 (no longer marketed by Roland) and accomplish many of the same things you can on the desktop.

But nothing besides the PMA-5 gives you so much sophistication in such a small package, and its diminutive size belies its amazing capabilities. I'm continually surprised by the depth, phrasing, and attention to detail evident in its arrangements, even though we're talking about popular music here. I've made room for it in my guitar case. □



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CIRCLE 119 ON READER SERVICE CARD

Software Dumping

When Microsoft says that the Internet Explorer browser is free and will remain free for all eternity, should we believe it? And why exactly is this one program free while others are not? Surely it is far more useful and important than the wallpaper and utilities

in the \$50 Microsoft Plus! for Windows 95, or the \$40 Julia Child CD-ROM on cooking. It's obvious that Microsoft is playing hardball with the browser competition just because Internet Explorer is not the market leader. There's a name for this: It's called *dumping*—the practice of selling a product below cost or giving it away in order to gain market share at the expense of weaker competitors.

Dumping is a horrible practice that first came to public attention when it was employed by the Japanese in various electronics markets such as televisions and semiconductors. Once the practice came under scrutiny, the playing field for semiconductors leveled out.

The concept behind dumping is simple: You find a market you want to take over, then you compare a competitor's ability to lose money by selling its product at a loss with your ability to sell at a loss. If the numbers are in your favor, you sell the product below cost until the competitor gives up or goes broke trying to keep up. Large companies with lots of money to burn use this technique to gain market share. In most sectors, it's considered an illegal business practice that the U.S. government will not tolerate. At least, it didn't used to tolerate it.

Why the federal government hasn't called Microsoft on this practice is interesting. Unlike most companies, Microsoft apparently has no limits to the business practices it can employ in its quest to dominate every aspect of the software business. This appears to be a classic case of dumping, plain and simple. The argument that Internet Explorer is being bundled as a loss leader to get customers "into the store to buy something else" just doesn't fly. What else? Windows? Is there some alternative to Windows of any significance that I'm unaware of?

I assume Microsoft would argue that Internet Explorer is free as a public service. Besides, the company would say, it'll always be free—it's just an added feature of Windows. "We think it's important and should be as much a part of the OS as File Manager. We give away File Manager and Windows Explorer, and nobody accuses us of

dumping. What dumping?"

I suppose one could argue that the MS-DOS module in Windows is being bundled as a loss leader too. But the question to ask about dumping isn't why something should or should not be bundled with other products, but why it is

being given away below cost. Is it to be competitive or to obliterate the competition? Nobody is hurt by the MS-DOS prompt in Windows. Microsoft already owns that market. By contrast, Microsoft is a Johnny-come-lately to the Internet scene, and it's clear the company is giving away Internet Explorer because Microsoft has only a 5 percent market share and little control of the blossoming market.

The obvious target is Netscape, whose Navigator browser currently dominates the market. Microsoft says it will give away Internet Explorer forever. Translation: as long as it takes to break Netscape. This practice has no other purpose than to destroy a competitor and put it out of business. Period. The tactic has an onerous effect on competitors, and it's obvious. I can't see any other explanation.

Free software is fine by me, but I just don't buy into any "doing the public a favor" arguments from Microsoft. Perhaps if Microsoft had shown some charitable inclinations in the past by, say, placing old MS-DOS source code into the public domain, I might (after a few beers) be willing to give the company a break. But I can still recall a long argument with Microsoft vice president Steve Ballmer

over the high price of OS/2 (back when his company was involved). "We have to cover the development costs," Ballmer kept telling me. Since Microsoft itself says that most of its staff members are now heavily involved with developing for the Internet, why are the development costs of this key product, its browser, somehow less important?

The funny thing is, Microsoft could easily compete in the browser market even if it played fair. It is far more service-oriented than Netscape, which has been overwhelmed by its own rapid success. Why Microsoft has resorted to dumping as a marketing strategy mystifies me. It appears to be in a panic. But panic is no excuse for dumping. □



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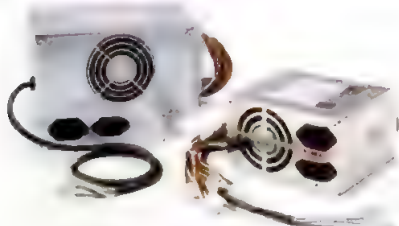
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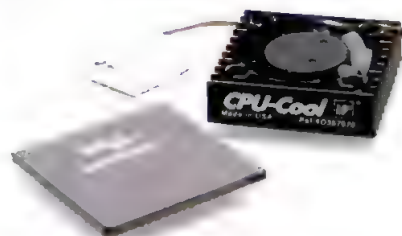
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CIRCLE 080 ON READER SERVICE CARD

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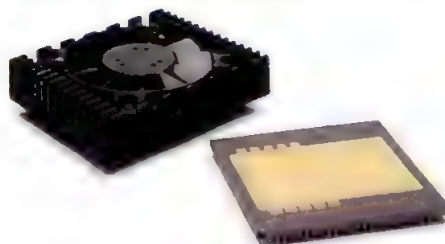
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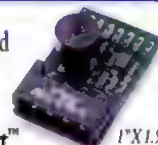
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Inside Track

Is the much-maligned **network computer** a lost cause? Look for various upstart chip companies to develop so-called multimedia chips for the network computer, a device to be connected to a TV set or cheap monitor and used specifically for exploring the Internet. The concept is nothing new, but the latest iterations promise to reach a **new price point**. Two phone companies are working on a plan to copy the French Minitel model. Various Regional Bell Operating Companies (RBOCs) have done the calculations and reckon that they can make a sub-\$199 or even a sub-\$100 device (with a keyboard plus a small monitor or TV connector) and amortize the costs. The key to making the concept a success is an **extremely low price**.

The network computer as initially envisioned by Oracle, Sun, and others is a \$500 system—far too expensive. Getting it down to \$100 may create a market.

Here's a good rumor that comes and goes: **US West**—my least favorite RBOC—is supposedly up for sale. And the company that wants to buy it is **British Telecom**. While there may be national security issues, you can be sure any current US West customer would applaud the idea. British Telecom has invested heavily in ISDN and pioneered smart-card usage in Great Britain.

Rethinking the Laptop Dept.: Over the past few years, I've discussed the idea of putting a **TV tuner inside a laptop or on a PC Card** with most of the laptop makers. Everyone says they've already tried this, and nobody is interested. But since I'm interested, and everyone I talk to is also interested, I'm not exactly sure who "nobody" is. Most laptop makers have already developed a TV tuner that can work with a laptop. The only problems are one, the device alone costs about \$1,000, and two, it's never been advertised or marketed.

Here are the **specifications for the product we need**: a PC Card with a full VHF/UHF/cable tuner. An antenna could be attached either via a dongle (ugghh!) or, more creatively, through a port. The TV tuner should have video capture and video in/out jacks for use with a VCR or camcorder. But the main use would be for TV. Road warriors who get stuck in airports would love to do something besides play solitaire. I've always been a fan of the TV tuner card that allows you to watch a little TV in the window of your monitor, so why not this?

While on the Subject of Laptops Dept.: I won't name names but on my way back from an event in Columbus, Ohio, I flew on a plane with a **huge contingent of Microsoft personnel** returning from a slew of meetings with CompuServe, regarding online services and browsers, among other things. I know this because Microsoft employ-

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a market.*

ees like to sit around public places, such as airports, with laptops with nice TFT screens and go through their e-mail. Let me tell you, these **screens can be read easily** from a distance. You can stand behind someone in the airport or in the aisle of the plane, and bingo! Memos for all to see. Did you know, for example, that Microsoft will ship between 60 and 70 million copies of Windows 95 in 1996? It's amazing what you can learn just standing around. There also seems to be a lot of discussion about bugs in Microsoft Exchange. Some of the messages were quite humorous. My advice to Microsoft employees: Be more circumspect.

Genuinely Interesting Software Dept.: One of the handiest programs around is PKZIP, used for archiving files. Unfortunately, to

make the process easy, you had to use a shell program or some other system to organize and update the archives. But these shells turned out to be too clunky and not powerful enough. And the release of PKZIP for Windows didn't help much either. Recently, I ran into a **\$30 Windows product called PROZip** that is absolutely incredible. All the zipping functions are built in, so you don't need PKZIP. This is not a shell. And it is completely graphical, with a slew of easy-to-use functions, parameters, and capabilities. Most important, **it's totally drag-and-drop**, so you can open an archive and drag over a complex set of subdirectories, and boom, they're zipped up, with directories and relationships intact. Even more impressive is the fact that you can open up a couple of different archives and slide files easily from one into the other, like dealing cards. Then you can encrypt and unencrypt after the fact.

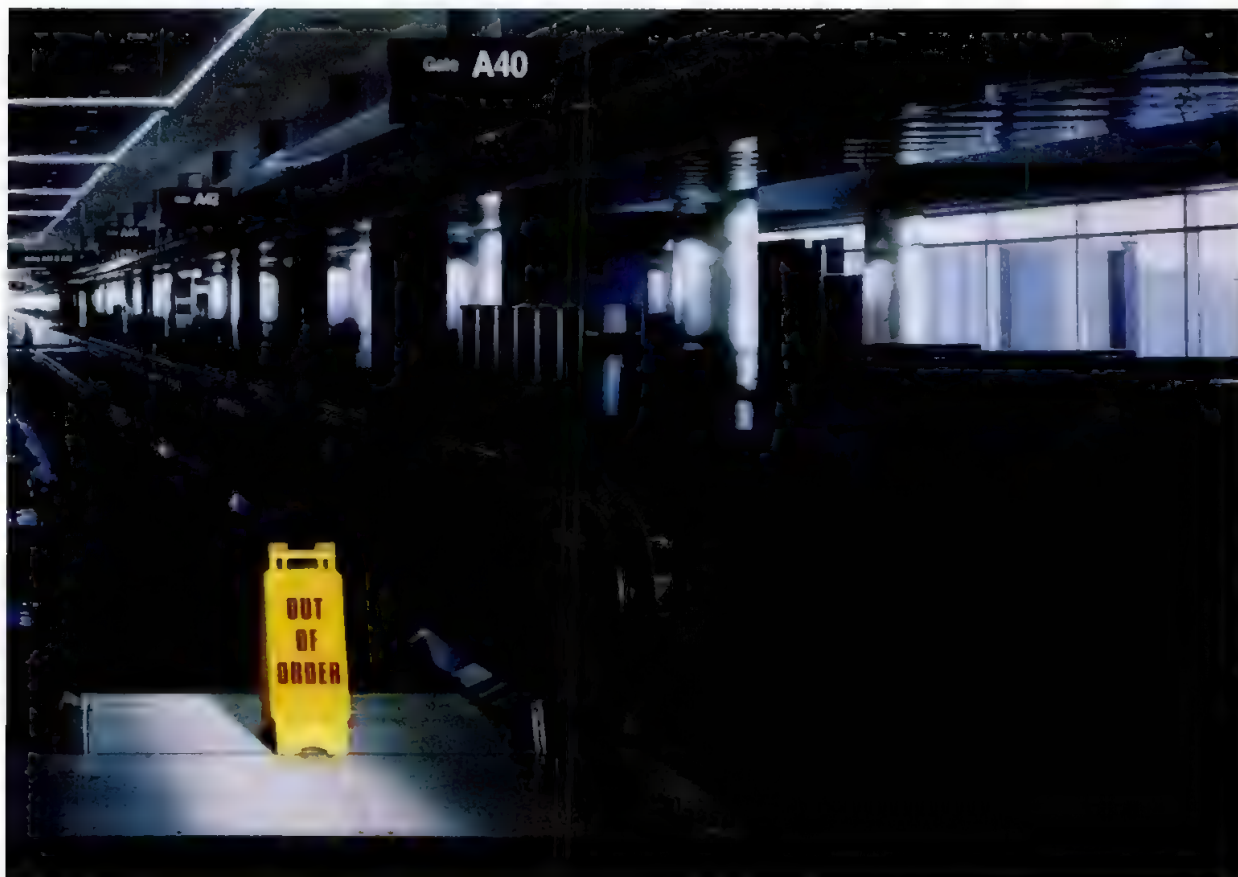
The problem? The program chokes on large files. Try and zip up a 230MB volume all at once, for example. But for routine maintenance and less ambitious tasks, it looks like a winner. The company is **RT Computer**, of Rio Rancho, New Mexico (800-891-1600). To try PROZip, download an "extract-only" version (1.2MB), from www.prozip.com, and then call the company for an authorization code to unlock the full program.

Resource of the Month Dept.: Do you have an old laptop with dead, dead, dead, really dead batteries? Or are you trying to get an extra battery for some device and the manufacturer of the device wants an exorbitant price? Well, I've experienced these problems, too. Now I call **Power Express** (408-879-1930; www.powerexpress.com). This company managed to get me a second battery for an IBM ThinkPad 560—overnight. Ask for the catalog. Power Express has a **slew of power-related gear** and seemingly every battery imaginable for laptops, cell phones, cordless phones, camcorders, you name it. The prices look unbeatable. □



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CIRCLE 034 ON READER SERVICE CARD

The Removable-Storage Mess

One of the glories of capitalism is that it gives us lots of choices. And one of the pains of capitalism is that sometimes that very multitude of choices can make things very confusing. The PC business often delivers wonderful examples of that conundrum,

which are now visible in the confusing market of removable-storage devices.

As program and file sizes have grown exponentially, to the point where office and graphics suites routinely ask for 100MB or more (often much more) hard disk space, and where a simple letter to a friend, nicely formatted, can easily consume 50K, the demand for removable storage has grown as well. No matter how fast hard disk capacity increases, our demand for storage space grows even more rapidly. So we turn to removable-storage devices to hold our inactive and overflow files and programs—and maybe to replace fixed hard disks themselves.

But what to choose? Chasing this rich market, vendors have created a bewildering array of devices. Pick the wrong one and you'll pay too much, get too little capacity and performance, and maybe find yourself with an orphan drive that uses media you can't buy any more.

All of us want at least four things from removable media: high capacity, low cost, high performance, and reliability. Many PC users also require broad compatibility; they want a device that is (or becomes) so popular that they can send a removable cartridge to a colleague or a service bureau and be certain that it will be readable at its destination.

If we define useful removable-storage devices as those that begin at 100MB of capacity but avoid the linear-access performance problems of tape, I can think of at least 20 different, incompatible "standard" devices fitting into this category. From Iomega's Zip drive and the new 3.5-inch, 120MB 3M-Matsushita LS-120 up through multi-megabyte optical cartridges, there's a vast range of choices. But there are only, I think, a few good ones.

Here are my recommendations. Keep in mind that there isn't just one winner: Your needs, budget, and future requirements may be different from mine. And remember the importance of market success. Even if you don't exchange media with others now or send artwork to a service bureau today, you may want to do so tomorrow. If the system you choose isn't in wide use, you may not be able to

transfer files with it. (Though if the system you choose uses an external drive, you can send it along with the media—clumsy, but workable.)

The clear winners in my opinion are Iomega's Zip and Jaz. I've written here before about how much I like the Zip system. Its 100MB capacity is less impressive today than it was a year ago, but given the new \$150 street price, the internal and external Zip drives are solid choices. They're available as both parallel-port and SCSI devices. And although the SCSI version is faster, the convenience of being able to move the parallel-port external Zip from one machine to another makes up, in my mind, for its slower performance.

Even more interesting—and a better buy for most PC users—is Iomega's 1GB Jaz. Unlike the Zip, it's strictly SCSI, internal or external. The 1GB cartridges cost \$100 each in five-packs; expect that to fall by 25 to 30 percent soon. The drives have fallen in price too: They now cost \$400 for the internal and \$500 for the external, as Iomega's production capacity has finally caught up with demand. These are the only devices in the removable-media derby I consider realistic replacements for (rather than extensions of) a hard disk. In fact, performance is so good, some third-party vendors are starting to build four-Jaz RAID arrays.

I think the Jaz is the big long-term winner. We'll see Zip drives and cartridges available for years; already, nearly every graphic-arts service bureau has

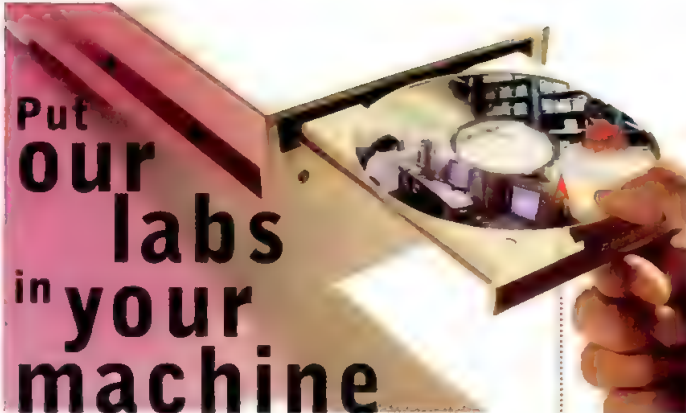
them. But the Jaz's combination of speed, capacity, and economy is so well tuned to the realities of the removable-storage market that I think it will be around for a long time. Undoubtedly, we'll see Jaz drives with capacities of 2GB or larger soon enough, but for now, 1GB is the sweet spot.

CD-Rs—recordable CDs—belong on this list, and for some uses and users are even better choices than Jaz cartridges. When I send a job to a DTP service bureau, or work to a client, I almost always send it on CD-R. I know what's on that disk, and I know that no one's going to accidentally erase a file and then claim it wasn't there—or alter it and then deny that. At about \$7 apiece, and maybe



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JIM SEYMOUR

half an hour to burn a full-capacity 650MB disk, CD-Rs are cheap, reliable, and nearly universal media. That near universality (who doesn't have a CD-ROM reader these days?) more than makes up for their relatively slow performance. CD-Rs aren't reusable media, of course. But at a penny a megabyte, that doesn't matter.

CD-Rs also make archiving easy and can be used for hard disk backup, too. Almost all of us have material on our hard disks that we'd like to clean out but still keep readily available. Backing up those files to tape lets you erase them from the hard disk but guarantees a slow and probably frustrating search-and-restore process the next time you need them. By contrast, files or programs archived to CD-Rs are readily found and don't need to be restored to the hard disk to be used.

With good CD-R drives under \$1,000 and better CD-R software (Adaptec's Easy CD Pro and CD Creator 2.0 are the best), making CDs is quick, easy, affordable, and a lot more reliable than it was six months ago.

The last entry on my list of practically sure things in removable media is Matsushita's 650MB PD phase-change cartridge. I've been using a Toray Phasewriter Dual PD/CD combo drive lately and have been surprised at how much I use and like it. At first I didn't get it; was there really a market between the Jaz's fast, \$100, rewritable magnetic disks and the slow, ultracheap, one-write CD-Rs? It turns out there is. For example, I use the PD/CD constantly for quick ad hoc backups. With \$500 drives and under-\$50 650MB cartridges, PD has a lot going for it.

There are several near-miss media types on my list. The 230MB MO cartridges and drives from Fujitsu and others are appealing, but they fall into the no-man's-land between capacity and performance. SyQuest's EZ-135 135MB magnetic cartridge drive works well and, at \$100, is a bargain. But Iomega trumped it soundly with the Zip, the clear survivor. I fear the momentum and earlier arrival in the market of Iomega's Jaz will similarly swamp the new SyQuest SyJet. And the 3M-Matsushita 120MB floppy disk is interesting, especially since it's also compatible with conventional 1.44MB floppy disks. But I think it probably arrived too late to market to become an important standard.

Removable media can solve a lot of problems. But buying the wrong form of removable media can be an expensive, frustrating mistake. □



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House for Sale

In the real-estate world, it's not uncommon for million-dollar estates to have selling brochures that can cost up to several thousand dollars to produce. But for a typical house, it's more likely that the listing agent will grab a thesaurus, produce two or three typed

pages of room descriptions laden with superlatives (one house we considered buying was called a "seraphic hide-away"), and tape a color photograph to the listing sheet.

In a lukewarm market, we sold our house in a week. Technology helped us do it. We called upon the resources one might have available in a moderately sophisticated home office, or in most any business office, to create an eight-page color brochure that wowed realty agents and helped set our house apart in the eyes of prospective buyers. All of it was done on a PC and all for about \$150 (not counting the hours invested in the project).

The tools you need are a flatbed color scanner (\$400 to \$1,000), a recent color ink jet printer (\$200 to \$500), a personal desktop publishing program (the default choice here is Microsoft Publisher, at \$139), and loads of free hard disk space. A monitor with 1,024-by-768 resolution also helps, so you can see your entire page without greeked text at the smallest point sizes. We also used Broderbund's 3D Home Architect (\$60), the best of the simple home CAD programs, to create floor plans. Rather than use an electronic camera, I shot traditional (film-and-paper) color photos of the interior and exterior and scanned them, because traditional photos are higher in quality and because affordable digital cameras can't accommodate the ultra-wide-angle lens (18mm) needed to photograph interiors.

I have a couple of advantages you may not: I've been in the business of working with words for 20 years; in a previous job I was forcibly exposed to publication design concepts; and I've taken photos professionally. Nevertheless, it's hard to louse up photos with today's auto-everything cameras, and DTP programs come with plenty of design templates you can modify. If you aren't confident in your writing abilities, run your work by a relative or coworker. Remember to run the spell checker and avoid fancy synonyms.

You may recall those Apple-does-DTP television ads a few years back, in which an actor clicked the mouse button twice, gazed at his laser printer as a gorgeous report slid effortlessly into the output tray, and then left

work early for his daughter's soccer match. Well, creating reports and brochures in the real world is hardly effortless. It's a time-consuming, painstaking undertaking. How hard? It rhymes with *rich*.

I encountered several stumbling blocks. Calibrating the scanner, monitor, and printer was a painstaking process, but you only have to do it once. Because we only made about 100 brochures, we printed them ourselves instead of using a copy shop, which would have charged 50 cents to \$1 per color page. While Microsoft Publisher is pretty good at most DTP tasks, it is absolutely clueless when it comes to helping you figure out how to print back-to-back originals. We used two sheets of paper per brochure, printed in landscape mode and then folded in half. Even stapling the fold took some ingenuity: You can buy a deep-throated stapler for \$25, or you can remove the base of a standard stapler, put a thick piece of cardboard underneath the paper, shoot the staples straight in, and then fold the staples by hand.

Printing on an ink jet printer was painfully slow: 400 pages at 1 to 2 minutes per page. And I found out the hard way not to stick in a batch of paper, hit Print, and go to bed: Many personal ink jet printers have minuscule ink tanks that go dry quickly—but the printer keeps on running. Also, if your paper is not well cared for ("store flat in a cool, dry place" turns out to be an important warning label), you invite jams. I tried

both a three-year-old printer and a one-year-old model. The newer printer provided better quality and was less prone to jamming.

The moral of the story: PC users of moderate ability can create presentations, reports, and fliers that are breathtakingly good. They'll make you stand out in your workgroup, with your clients, or with the other parents in your kids' soccer league. Your presentation may be the catalyst for a winning sales pitch. It could even help you get a raise. The only drawback is that once your bosses see how good the documents look, they'll probably ask you to create more reports and presentations. No good deed goes unpunished. □



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NETWORK EDITION

NETWORKED CD-ROM SERVERS

CDs Served Up Hot

A networked CD-ROM server is a good investment for managing your CD-ROM titles and assuring access for all users.



By Steve Rigney

A few network administrators might argue that the days of the network CD-ROM server are numbered. After all, almost every new PC comes with a CD-ROM drive, and disk drives continue to drop in price. Though that may be true, today's CD-ROM server does not just provide inexpensive access to CD-ROM drives. It also provides multiple simultaneous—and speedy—access to shared sources of information.

Keep in mind that when you buy a new CD-based application or database, the vendor probably won't provide you with enough CDs for all your users. And an added benefit

INSIDE



Was there ever a handier medium than the CD-ROM? Handier? No. Tougher to hold onto and keep track of in an office setting? Well, it's got some competi-

tion, but there's nothing with the same capacity-plus-portability appeal. That's why we continue to recommend that you install one of the many CD-ROM server solutions on the market—so that all your users can access all your CD-ROM titles.

IN THIS ISSUE, WE'VE rounded up new releases or updates of four leading hardware-based CD-ROM network server solutions. Contributing editor Steve Rigney tested them for ease of installation and use, management features, and speed of access. Even this small group represents a range of solutions. Across the whole market, you've got quite a variety of approaches to choose from.

RIGNEY ALSO ASSESSES two new e-mail servers for you in our First Looks section. It's a new take on an old idea. Instead of a standard LAN-based e-mail solution, consider setting up one of these Internet (or intranet) servers. Rigney reports that both systems are flexible and provide good security and management. Ipswitch pays special attention to the client side of mail, while Digital provides some particularly handy management utilities. (Page NE 19.)

FRANK DERFLER, OUR senior networking editor, says he knows who you are and he saw what you did. For details, see Multiple Access. (Page NE 24.)

FINALLY, THIS WILL BE my last Inside column for the Network Edition. I'm moving on to other challenges here at *PC Magazine*. Taking over as the senior editor in charge of Network Edition will be Leon Erlanger. Look for his first column here in the next issue.

—Gail Shaffer

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- 512KB write-back cache, flash BIOS
- Slots: 5 EISA, 2 PCI, 1 EISA/PCI
- Adaptec PCI 32-bit Ultra SCSI Fast-20 controller
- 8X SCSI-2 CD-ROM drive
- 3.5" floppy drive
- 64-bit 1MB ISA video
- 3Com 3C595 PCI 10/100 Ethernet NIC
- Full-size tower with 10 drive bays
- Microsoft Mouse, 104-key keyboard
- Novell NetWare 4.1 (5 user license)
- NOS support (3 free resolutions)
- 5-year/3-year Micron PowerSM warranty

- 32MB RAM • 2GB Ultra SCSI hard drive
- 15" Micron 15F6x, .28dp (13.7" display)

\$4,999 Business lease \$176/month

- 64MB RAM • 4GB Ultra SCSI hard drive
- 15" Micron 15F6x, .28dp (13.7" display)

\$5,899 Business lease \$185/month



pentium

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of a CD-ROM server is that it keeps all your CDs organized in a safe place.

There are dozens of CD-ROM servers on the market, ranging from software-only solutions that run on DOS-based PCs to high-end hardware/software jukebox solutions that can handle hundreds of CDs and users. In this roundup, we look at four leading hardware/software turnkey solutions. These products come with everything you need to establish a CD-ROM server on your network. They are Logicaft Information Systems' LanCD/XF 5500, Meridian Data's CD Net 807, Microtest's DiscPort Tower, and Plextor's PlexServer.

WHAT'S IN THE NOS

Most modern desktop OSs include a built-in peer-to-peer network that enables you to share your CD-ROM drive with others on the network. Even servercentric NOSs, such as NetWare and Microsoft Windows NT, include utilities for sharing CD-ROMs.

These utilities are useful if you need to share a CD occasionally to update or install an application, but they don't offer the same management and remote-configuration features as the products we reviewed.

Server-based utilities, particularly NetWare's, are not as easy to install and use, and they take longer to mount and dismount CD-ROMs. They also have the additional load of serving multiple CD titles from overworked file and print servers. If you have five or more people accessing network

CD-ROMs, then instead of using the utility that comes with your NOS, we recommend using one of the products in this roundup.

THE TWO TECHNIQUES

The products in this roundup use two techniques for sharing CDs on the network: standalone and server-based drivers. Standalone devices, such as the XF 5500 and the PlexServer, do not require another network server on the LAN. (Procom Technology offers the CD Force, a standalone solution, but its recent upgrade was not ready in time for review.) The CD-ROM server chassis includes a PC and proprietary software that makes the PC

powerful management software.

The DiscPort comes in 7 and 14 6X internal CD-ROM drive variations and works across NetWare or Windows NT. We were especially impressed with the DiscPort's ability to handle CDs as NetWare or Windows NT volumes, eliminating the need for special client software.

Its management utility, DiscView PRO, lets you control all of your CD-ROMs from a single location. Unfortunately, this software is currently not

appear as a network file server.

Setup is as simple as loading the proper network protocols and attaching to the CD-ROM servers. The standalone technique is our favorite, because it doesn't require you to load any resource-hungry drivers on your important file servers. And because you have an entire PC dedicated to the task of sharing CDs on the network, this approach can also provide the best performance. But standalone CD-ROM servers are generally more costly than their server-reliant counterparts.

Products such as the DiscPort Tower and CD Net 807 require you to load drivers on your file server in order to publish CDs on the network. Both of these products require loading NLMs on your NetWare file server before the user can access the shared CDs. Although the DiscPort Tower can also work with a Windows NT server, the CD Net 807 is limited to NetWare 3.x and later versions. These products both require a network server, but that is the extent of their similarity.

The DiscPort Tower uses the network server to mount the shared CDs as network volumes so any network client can access them. The CD Net 807 uses the network server only to provide the network protocols and the connectivity between users and the device; you still have to load proprietary software on the client PCs. This means that the CD Net 807 requires a full PC in the chassis, while the DiscPort Tower can use the file server's processor

Microtest DiscPort Tower

All the products in our roundup are solid solutions for networking CD-ROMs. The Microtest DiscPort Tower receives our Editors' Choice for its mix of ease of use, flexibility across OSs, and

available for managing CDs on Windows NT networks. Though the DiscPort trailed on our performance tests, it still proves a viable solution for small to medium-size LANs.

We give an honorable mention to the Logicaft LanCD/XF 5500, which turned in the best performance in our testing. The XF 5500 is notable for its easy setup and user-friendly software. It may be a bit bulky, but then it's built to handle serving up CD-ROMs over large networks.



and RAM to cache and share CD-ROMs. The biggest drawbacks to this technique are the need for a server on your network and the added requirements of the drivers.

All the products in this roundup provide some form of scalability. Whether it's the ability to add more CD-ROMs to the chassis, daisy-chain servers together, or simply connect more devices to your LAN, these solutions let you add more CDs to your network as demand increases.

For example, with a single XF 5500 in place, you can use a CD-ROM jukebox to connect as many as 1,280 platters to your network. And you can connect as many as 63 DiscPort Towers to your NetWare LAN for a total of 882 networked CDs.

MANAGEMENT

Although all the products in this roundup enable you to monitor and control your CD-ROM servers from a remote location, the management utilities offer different features and capabilities. Some of the most important features allow you to mount a CD automatically when it's inserted into the drive and limit access to CDs based on user names and passwords.

Microtest's DiscView PRO utility is our favorite management application, because it allows you to view and control all of your DiscPort devices with a single, easy-to-use menu. Products such as Logicaft's XF 5500 limit you to managing only 10 CD-ROM servers from a single location.

All the products we tested can be man-

FEATURES PLUS

From September 9 to 13, join Contributing Editor Steve Rigney and analysts from Logicaft and Microtest for a discussion of network CD-ROM servers. Through CompuServe (GO PCMAGNET), you can download PC Magazine utilities (GO TIPS) and join in the discussion (GO EDITOR).

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NETWORK EDITION

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aged and viewed from a remote location. But only the LanCD and PlexServer let you monitor and perform basic management tasks from the server.

CLIENT ACCESS

The way you attach to the server to use CDs is one of the most important areas to consider when looking at these products. Most modern networks are heterogeneous and consist of various users running different OSs that are attached to multiple servers and use multiple network protocols.

So, a good CD-ROM server solution must work with different OSs on client PCs. We prefer solutions that do not require client software. The PlexServer NT appears as a NetWare server and requires only that you log onto the device to access CDs. The DiscPort Tower doesn't appear as a NetWare server, but CDs appear as NetWare volumes. As with the PlexServer, the only client software you need are NetWare drivers.

The CD Net 807 and the XF 5500 require proprietary client software on all the PCs that need access to shared CDs. Fortunately, both vendors include software for most major desktop OSs.

As more applications and databases begin to arrive on CD, these servers are going to become as important as any other device on your network. With their powerful management utilities, easy-to-use client software, and strong security, CD-ROM servers should be around for a long time.

Logicraft Information Systems

Logicraft LanCD/XF 5500

ALL REVIEWS BY STEVE RIGNEY

Weighing in at over 110 pounds and costing just under \$24,000 (tested configuration), the LanCD/XF 5500, from Logicraft Information Systems, was truly the heavyweight of our roundup. All that muscle pays off too: This blazingly fast CD-ROM server led the field in performance testing.

This tower houses 14 6X CD-ROMs, a 120-MHz Pentium CPU with 32MB of RAM, and 2 4.2GB hard disks. It has a maximum capacity of 1,280 platters when used with CD-ROM jukeboxes. The unit we tested came with 12 CD players installed. The FastCD utility caches CD data to the unit's two large hard disks, speeding up data access by nearly 300 percent.

Setting up the LanCD was painless. It ships preloaded with the LanCD server software. We connected the XF 5500 to our LAN using coaxial cable (our review unit did not come with a 10Base-T/RJ-45 connector). The server booted up and immediately scanned the drives for disks.

Unlike Microtest's DiscPort Tower and Plexor's PlexServer, the XF 5500 does not appear to the network as a NetWare server. Because the mounted CDs are not mounted as volumes, you must use the LanCD client software to map your drives. The XF 5500 works with four different protocols at the same time: IPX/SPX, NetBIOS/NetBEUI, TCP/IP (\$499 extra), and VINES.

Client software (\$699 for a 10-user license) is required to connect to, map, and manage the CDs in the server. It is available for Windows 3.1, Windows for Workgroups, and Windows 95. Windows NT and Macintosh users must purchase separate client packs, and XF 5500 does not come in an OS/2 version. As a VxD (virtual device driver), XF 5500 does not consume conventional memory.

Built-in CD-ROM extensions in the client reduce the client PC's memory requirements. As with the Meridian CD Net towers, mapped CD-ROMs appear as local instead of network drives. This is a nice feature, because some CD-based programs will not work if they are not on a local-drive letter.

You use the XF 5500 manager utility, LanCD, to change server parameters, view server activity, and lock, unlock, and eject CDs. Although you can have an unlimited number of servers on the LAN, you can manage only 10 servers from any one client. A license-metering application helps monitor the number of users accessing a particular disk.

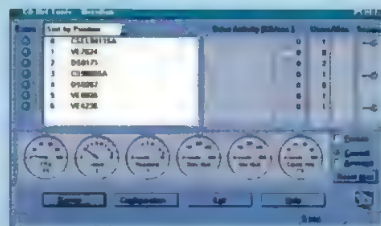
The XF 5500 is best suited to networks with a large number of users who require access to data contained on multiple CD-ROMs. It boasts exceptional performance and user-friendly software, but its sheer cost and bulk probably limit its market reach. **Logicraft LanCD/XF 5500.** List price: Tested configuration, \$23,797. Logicraft Information Systems, Nashua, NH; 800-880-5644, 603-880-0300; fax, 603-880-7229; www.logicraft.com. Circle 953 on reader service card.

Reflecting on CD-ROM Servers



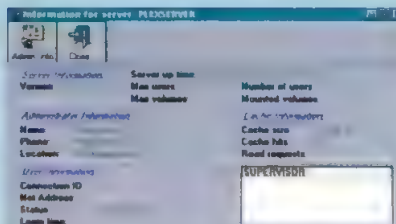
TOO MUCH SERVER

Logicraft's bulky LanCD/XF 5500 provides big performance, but it's a space hog.



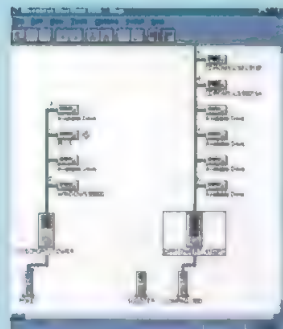
CONTROL PANEL

You can easily monitor the health of Meridian Data's CD Net server using the CD Net Tools utility.



MANAGEMENT

Plexor's Lite PlexServer provides only skimpy remote-server management and statistics reporting.



USER FRIENDLY

Microtest's DiscPort Tower DiscView PRO is not only the most powerful utility we saw, it is also the easiest to use.

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Network CD-Recordable Servers

By Russell Iwanchuk

The CD-ROM servers in our main roundup make the data on shared CD-ROMs available through a local file system. Products like the JVC Information Products of America's \$3,295 Network RomMaker, Version 3.20, and Meridian Data's \$995 CD NetRecord for NetWare, Version 1.0, enable network users to burn data to a shared compact disk-recordable (CD-R) drive on the network.

With the surge in the number of CD-ROM drives on the desktop and the plummeting prices of CD-R blank media, CD-ROMs are gaining popularity as a convenient way to distribute and archive data. You can pack a lot of data onto a CD-ROM (about 650MB), and you can expect its data to remain viable longer than data stored on magnetic media. A shared CD-R drive saves the cost of having one on the desktop of every user, and you can manage and limit users' access to the drive.

JVC's Network RomMaker uses peer-to-peer networking to connect client to server. It works with IPX and NetBIOS network protocols, but the client software runs only on Windows 3.x. It includes an Adaptec SCSI adapter and an external unit that houses a Yamaha 4X CD-R drive and a SCSI hard disk. The SCSI hard disk acts as cache for the CD-R disk. An image of what is to be copied to the CD-R disk goes first to the SCSI disk, so it can provide the fast and steady data stream CD-Rs require as they burn a disk.

Setup involves installing the SCSI card into the PC you choose as a server (an old 386-25 will do), and plugging the external unit into the SCSI adapter. The Windows-based client software is intuitive and makes setting up a CD-R job simple. Unfortunately a hefty 27K TSR must be loaded for the client software to see the server.

Meridian Data targets the NetWare-installed base with a server-based software-only solution. CD NetRecord for NetWare is less expensive than its JVC counterpart, but you must purchase a CD-R drive (we tested with an HP SureStore 4020i), a SCSI adapter, and a SCSI disk drive separately.

Everything must be installed in a NetWare server (3.12 or 4.10) running Meridian Data's CD Net (reviewed in the main roundup). You also need 700MB of hard disk space on the same server, which is used as a staging area to arrange the CD-R image before sending the job on. The software is easy to install, integrates well with NetWare, and makes administration of the CD-R server straightforward. The client application is as easy to use as JVC's and runs on Windows.

Network RomMaker, Version 3.20. List price: \$3,295. JVC Information Products of America, Irvine, CA; 714-261-1292; fax, 714-261-9690; www.jvcdiscusa.com. *Circle 957 on reader service card.*
CD NetRecord for NetWare, Version 1.0. List price: \$995. Meridian Data Inc., Scotts Valley, CA; 408-438-3100; fax, 408-438-6816; www.meridiandata.com. *Circle 954 on reader service card.*

Meridian Data Inc.

Meridian CD Net 807

Meridian Data has always provided quality CD-ROM server solutions, and the flexible, speedy Meridian CD Net 807 turnkey solution is no exception. It is, however, somewhat limited, because it works only with NetWare and lacks support for frame types other than 802.2.

The CD Net 807 is a seven-disk, 6X mini-tower chassis with a proprietary processor, 512K of RAM, and an integrated 10-Mbps Ethernet adapter. Because it depends on NetWare, you must load a few NLMs on your file server. Meridian is working on adding Ethernet 802.3, but for now you must use the Ethernet 802.2 frame type. Although there are no external SCSI ports for daisy-chaining additional towers, you can have multiple servers on the same LAN.

We installed the CD Net 807 server and CD Net Plus software in only minutes. The unit we tested came equipped with an RJ-45 connector for 10Base-T. Connectors for 10Base2 (coaxial cable) Ethernet are also available, but Token-Ring is not an option.

CD Net Plus can be installed from a client PC on the LAN. After completing server installation, you can customize the client install by specifying which features

of CD Net Plus your clients can access. This enables users to run the setup routine from the file server. CD Net Plus's client software runs on DOS, Windows 3.x, Windows 95, and Macintosh client PCs. Unlike with Microtest's DiscPort Tower, the mounted CDs do not look like NetWare volumes, so OS/2 or Windows NT clients cannot map a drive to them.

CD Net Plus includes CD Access, CD Admin, CD Map, CD Menu, and CD Net Tools. CD Admin is a graphical utility that administrators use to manage the CD-ROM servers. CD Map's simple pull-down menus make it easy to map or unmap a drive letter to a CD. CD Net Tools is a performance monitor that integrates with Novell's ManageWise.

CD Net Plus client software makes a network CD look like a local drive letter, which means you don't have to load Microsoft's CD-ROM extensions (MSCDEX) on your PC. CD Net Plus also enables managers to lock drives to prevent a disk from being removed. When you map a drive on the CD Net server, you can specify whether mapping is temporary or permanent. Mapped drives appear as local drives to the client.

Although the CD Net server doesn't have the expandability of Plexor's PlexServer or the client OS flexibility of Microtest's Disc-

Port Tower, it will meet the needs of many small to medium-size workgroups very well. Its ability to spoof MSCDEX is a great advantage, but its dependence on NetWare is limiting to those using other NOSs.

Meridian CD Net 807. List price: Tested configuration, \$5,795. Meridian Data Inc., Scotts Valley, CA; 800-767-2537, 408-438-3100; fax, 408-438-6816; www.meridiandata.com. *Circle 954 on reader service card.*

Microtest Inc.

DiscPort Tower



As another longtime player in the network CD-ROM market, Microtest has used its experience to create the impressive DiscPort Tower. One of the best solutions on the market for the many NetWare-based workgroup networks, the DiscPort still could stand some improvement. It doesn't work over TCP/IP or provide software for managing CDs on Microsoft Windows NT networks, and it lagged a bit in our performance testing.

Available with 7 or 14 internal 6X CD-ROM drives, the DiscPort Tower works across NetWare or Windows NT networks. We tested with the seven-drive version



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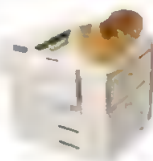
As they barked to marketing about end-user software, we perfected code that also gives administrators unprecedented power to monitor and control usage across the network.

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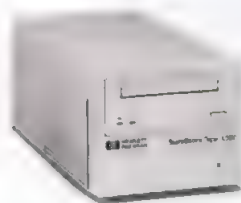


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HP SureStore Tape drives

COVER STORY

(\$5,695; \$10,495 for 14 drives). Installation is as simple as connecting the tower to your network cable and running a short installation utility that automatically connects to your server and loads the correct NLMs or Windows NT service packs. The product allows you to attach as many as 63 DiscPort Towers to a NetWare server or an unlimited number of devices to Windows NT.

Because the DiscPort treats each of your CDs as a NetWare or Windows NT volume, client PCs do not require special software. In fact, the DiscPort will work with any client OS that can connect to a NetWare or Windows NT file server. To access a network CD, the user need only connect to the file server and map a drive to the shared CD-ROM volume. The DiscPort does not allow you to map a CD as a local drive or permanently assign a drive letter to a specific CD-ROM slot on the tower, but the DiscPort DPCDEX utility spoofs the CD into recognizing the drive as local. This is important for CD titles that require a local CD-ROM drive or MSCDEX (Microsoft CD-ROM extensions) to work correctly.

DiscPort's DiscView PRO program was the most powerful and easy-to-use administrative utility we saw. It runs on Windows 3.x, Windows 95, or Windows NT and provides centralized management for all DiscPort devices. Although DiscView PRO runs on Windows NT, it does not currently come in a version that allows you to manage DiscPort Towers on a Windows NT network. DiscView PRO's selector view lets you view all of your NetWare servers and DiscPorts, connect the DiscPorts to different servers, unload the DiscPort NLMs, and mount or dismount CDs. The map view lets you map a particular drive letter to a CD and perform other housekeeping duties.

Users can attach to network CDs using SmartLaunch, a small utility that runs on Windows-based client PCs. SmartLaunch automatically logs onto a file server, maps a drive letter to the shared CD, launches the application, and updates program files. It can also unmap the drive letter and log off of the file server for you.

The DiscPort was the slowest contender on our performance tests. Because the DiscPort relies in part on NetWare's file and directory caching, the speed and amount of RAM in your server affect performance. Nevertheless, the DiscPort is easy to install anywhere on your network and offers a great management utility and flexible client access. We await the next version, in which we hope to see increased support for network protocols and improved support for Windows NT.

DiscPort Tower. List price: Tested configuration, \$5,695. Microtest Inc., Phoenix, AZ: 800-526-9675, 602-952-6400; fax, 602-952-6401; www.microtest.com. *Circle 955 on reader service card.*

Plextor Corp.

PlexServer

If you're considering an expandable, easy-to-use CD-ROM server solution, Plextor's PlexServer (\$8,699) merits a look. It was easy to set up and requires no file server. But because of its 8X CD-ROM drives, we expected to see better than the average performance it demonstrated in our testing.

Inside the rugged tower chassis is a 486 DX/2 66-MHz system with 4MB of RAM and an 80MB IDE hard disk. The Novell

version of PlexServer uses its RAM for caching, and the Windows NT version relies on its hard disk for caching CD-ROM data.

The unit we tested came with seven 8X drives attached to one of four SCSI-2 adapters. You can add three more external seven-drive CD-ROM towers, for a total of 28 mounted CD volumes. The PlexServer is licensed by the number of concurrent users. You can buy licenses in 10-, 100-, and 250-user blocks. There is no limit to the number you can have on the LAN, and you can manage all from one PC.

Included with the PlexServer package is Ornetix's CD-Vision server software and CD-Commander client software. (PlexServer's Microsoft Windows NT version uses Optical Technology Group's CD-Extender software.)

SUMMARY OF FEATURES

Networked CD-ROM Servers

	Logcraft Information Systems LanCD/XF 5500	Meridian Data Inc. CD NET 807	Microtest Inc. DiscPort Tower	Plextor Corp. PlexServer
■ YES ■ NO				
Products listed in alphabetical order				
List price	\$23,797	\$5,795	\$5,695	\$8,699
Hardware				
Processor/speed	Pentium/120	80186/20	386EX/25	486DX2/66
Standard/maximum RAM	32MB/32MB	512K/512K	1MB/1MB	4MB/128MB
Hard disks	Two 4.2GB	None	None	One 80MB
Floppy disk drive	■	■	■	■
Supports Ethernet/Token-Ring	■ ■	■ ■	■ ■	■ ■
Supports 10Base-T (UTP) cabling	■	■	■	■
CD-ROM drives:				
Number	12	7	7	7
Data-transfer rate	1,000 Kbps	670 Kbps	900 Kbps	1,200 Kbps
Rated access time (milliseconds)	120	165	140	115
Buffer size	256K	256K	256K	256K
Software				
Client OSs supported:				
DOS 6.0/Macintosh	■ ■	■ ■	■ ■	■ ■
OS/2 2.11, OS/2 Warp 3.0	■ ■	■ ■	■ ■	■ ■
Windows 3.x/95/NT 3.51	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Protocols supported:				
IPX and SPX	■	■	■	■
NetBIOS and NetBEUI	■	■	■	■
Native TCP/IP	■	■	■	■
Uses NLM/TSRs	■ ■ *	■ ■	■ ■	■ ■
Client-side software	■	■	■	■
Security and Administration				
Provides view of server activity	■	■	■	■
User can set up and monitor software licensing	■	■	■	■
User can administer server from remote client	■	■	■	■
Lockable cabinet and CD-ROM drive	■	■	■	■

*DOS clients use TSRs.

PC MAGAZINE
NETWORK EDITION
EDITORS' CHOICE

*Making everything
work with everything shouldn't be*

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From your desktops to your hosts, IBM Enterprise Communications Software connects and makes the most of all your applications, platforms and networks, while it saves you time and money.

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Setup involved plugging the server into our LAN using a 10Base-T patch cable (the PlexServer also comes with BNC and AUI adapters) and turning on the power. The server booted directly into the CD-Vision server software. After loading a CD, we were able to use Windows 95 Explorer to browse the new server and map a drive letter to the CD. The PlexServer appears as a NetWare file server to network clients, and all of the mounted CDs appear as volumes on the server. You can map drive letters to

mounted CDs using NetWare's Map command at a DOS prompt.

The graphics-based CD-Commander client software is available for Windows and includes utilities for the user and the network administrator. Client software is not needed to mount or manage CDs in the PlexServer. CD-Commander lets you create a CD title that links to a specific CD anywhere on the network.

CD-Commander also helps you manage specific drives and user access to the server. It provides some software metering:

You can create user groups and set access rights to specific CD titles.

Though its performance was not quite what we expected from an 8X player, the PlexServer is expandable and easy to set up and manage. If you are more concerned about price and performance, you'll want to investigate other servers.

PlexServer. List price: Tested configuration, \$8,699. Plexor Corp., Santa Clara, CA; 800-475-3986, 408-986-1010; fax, 408-986-1010; www.plexor.com. Circle 956 on reader service card.

PERFORMANCE TESTS

CD-ROM Servers



Our testing showed that the speed of the CD-ROM drive does not guarantee rapid performance; fast components may be a better indicator. Logcraft's 6X LanCD/XF 5500 led the pack, far surpassing an 8X contender.

What the Numbers Mean

As CD-ROM drives get faster, bottlenecks occur in the server's processor, hard disk, and network adapter. The solution with the fastest components—processor, hard disk, RAM, network adapter, and OS—usually provides the best performance. The leader in our testing, Logcraft's LanCD/XF 5500, includes a 120-MHz Pentium processor with 32MB of RAM and two Fast SCSI 4.2GB hard disks. All of this hardware is dedicated to publishing CDs on the network.

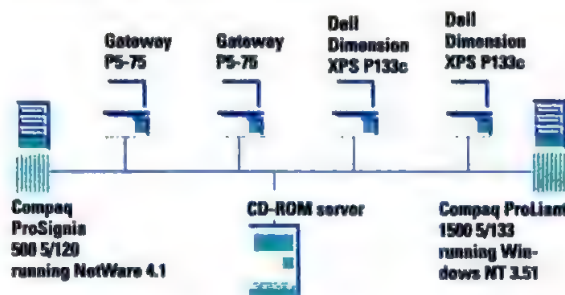
The slowest performer here, Microtest's DiscPort Tower, doesn't include much hardware in the CD-ROM server other

with 4MB of RAM—our test unit had a total of 12MB of RAM—and an 80MB IDE hard disk. The Ornetix software also ran as an application under 16-bit DOS. These slower resources can have an effect, especially as you add more users and load to the server.—*Analysis written by Steve Rigney*

How We Tested

All of the products reviewed were standalone servers. Some require a NetWare or Microsoft Windows NT server; others don't even require a NOS. We set up both NOSs, but we ran performance tests over the NetWare network. To simulate a real-world environment, we used a mix of systems for our four client PCs. All of the clients ran Windows 95 and were attached to both the Windows NT and NetWare servers.

Our Database test involved mounting four Information Access Computer Select LAN CDs on each CD-ROM server. Each CD contained more than 70,000 articles from computer periodicals. A single client was attached to a different CD in the



TEST-BED: Network CD-ROM servers.

	MULTIMEDIA Min:sec	DATABASE Seconds
Logcraft LanCD/XF5500	1:16	17.4
Meridian CD Net 807	1:59	37.9
Microtest DiscPort Tower	2:06	53.5
Plexor PlexServer NT	2:04	49.1

◀ BETTER

◀ BETTER

than SCSI adapters and CD-ROM drives. The DiscPort Tower relies on the NetWare file server for file caching. Although this is a good way to make use of NetWare's powerful multitasking and dynamic caching, it can slow down your server. Likewise, a server busy handling file and print requests from client PCs will slow down your CD-ROM server.

The other slow performer, Plexor's PlexServer, came with the fastest CD-ROM drives and didn't require a NetWare file server for caching. But the PlexServer is built on a 486 CPU

server. We simultaneously launched Computer Select on each of the client PCs and performed a Boolean search using the words "Microsoft" and "Windows." We measured the time it took for all of the clients to complete the search. We used the same four Computer Select CDs in each server each time and attached the client PCs to the server.

To test multimedia performance, we attached a single Dell Dimension 133-MHz Pentium to each server and mounted a single Windows 95 CD. We accessed the 31MB Weezer .AVI video file, turned off the sound synchronization to allow the file to play as fast as possible, and timed the results. We performed both the database and multimedia tests at least three times to confirm results.



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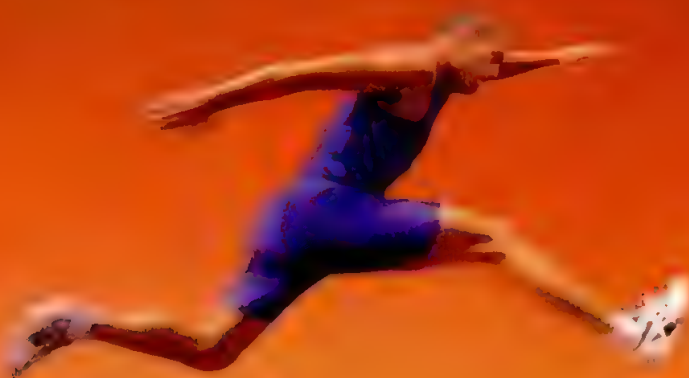
Model	Capacity	Seek	Rotational Speed	Internal Transfer Rate	External Transfer Rate
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Medalist Pro 3440	3.4 GB	10.3 msec	5,400 RPM	87 Mb/s	16.6 MB/s
Medalist Pro 2520	2.5 GB	11.0 msec	5,400 RPM	116 Mb/s	16.6 MB/s

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aspects of CD-ROM sharing, and to improve your peripheral vision in general. Just log onto our web page at <http://www.axisinc.com> and check out our complete line of network peripheral products, as well as our free guide *How to Share CD-ROM Resources on Networks*.

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

INTERNET MAIL SERVERS

Mail Systems Move Beyond the Message

By Steve Rigney

Not so long ago, if you wanted to set up an Internet or intranet e-mail server on your LAN, you had to speak fluent Unix, understand e-mail gateways and routers, and know the TCP/IP protocol and addressing techniques backward and forward. Now you can install and maintain an Internet or intranet e-mail server almost as easily as a LAN-based e-mail system, such as Lotus cc:Mail. But why install an Internet-based e-mail system instead of a LAN-based solution? Two words: greater flexibility.

An Internet or intranet e-mail server allows you to use almost any e-mail client software, such as Eudora, Microsoft Exchange, or Netscape Navigator, running on almost any platform, including Mac OS, OS/2, Unix, and Windows, to send and receive electronic mes-

sages. You can also attach your e-mail server to the Internet, so that users can correspond with the rest of the world and your customers can keep in touch with you.

In this mini-roundup, we look at two of the newest Internet and intranet e-mail solutions, Digital AltaVista Mail and Ipswitch IMail. Each runs on Windows NT, provides SMTP and POP3 e-mail services, and is a snap to install.

Digital Equipment Corp. AltaVista Mail

True to its design, Digital's AltaVista Mail 1.0 does the job as a powerful Internet or intranet messaging server with strong security, excellent management, and an interface that is easy to install and use. But unlike Ipswitch's IMail, AltaVista Mail doesn't provide an e-mail client or other useful features

such as rules-based e-mail, automatic vacation replies, or WhoIs, Finger, or list servers. Digital provides APIs to create such utilities, but doing so isn't easy.

Like IMail, AltaVista Mail retails for \$495 per server and includes unlimited licenses for e-mail clients. The product also works with SMTP and POP3 protocols and allows you to send any type of file format using the MIME specification.

If we thought IMail was easy to install, we found AltaVista Mail even easier. All

EXPLORE: The exploring utility lets you see servers, users, and mailboxes from one screen.

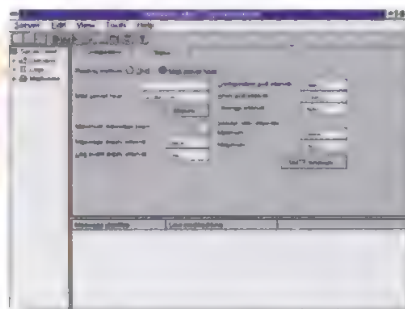
you have to do is provide a host name for your mail server, and the installation utility does the rest.

We were glad about that, because other than a short text file on the CD-ROM, no installation information is provided.

When you install the product, you can configure your server for a full Internet con-

nection or dial-up access. The product also includes a server test utility that checks the installation and the server to make sure everything is connected and functioning properly. Like IMail, the product runs on Windows NT 3.x, but unlike IMail, AltaVista Mail also works with the beta release of Windows NT version 4.

After you install the software, you can use the administration utility to perform all your mail tasks. For example, from a single menu you can set up your server, add users, for-



ward e-mail messages, change passwords, create a mailing list, test the server, and explore your current server.

The Explore Server utility is especially handy. You can see the status of your server, create users, monitor error logs, and create mailboxes, all from a single menu. You can also perform tasks such as checking the status of any firewall, changing the SMTP time-outs, and changing time intervals for checking messages.

The excellent logs for monitoring administration and security events and errors that occur on your server are a real strength of AltaVista. Though complicated to read, these logs gather crucial information. For example, we could see when a user tried to access the server with the wrong

SUMMARY OF FEATURES

Mail Servers

■ YES □ NO

Products listed in alphabetical order

	AltaVista Mail 1.0	IMail Server for Windows NT 2.61	Lotus Notes 4.0*	Microsoft Exchange Server 4.0*
Runs on Windows NT	■	■	■	■
Client software	■	■	■	■
Compliant with POP3	■	■	■	■
Compatible with SMTP and MIME	■	■	■	Optional
Rules-based messaging	■	■	■	■
Built-in vacation option	■	■	■	■
List server	■	■	■	■
Provides threaded discussions	■	■	■	■
Whois/Finger utility	■	■	■	■

* Reported for comparison

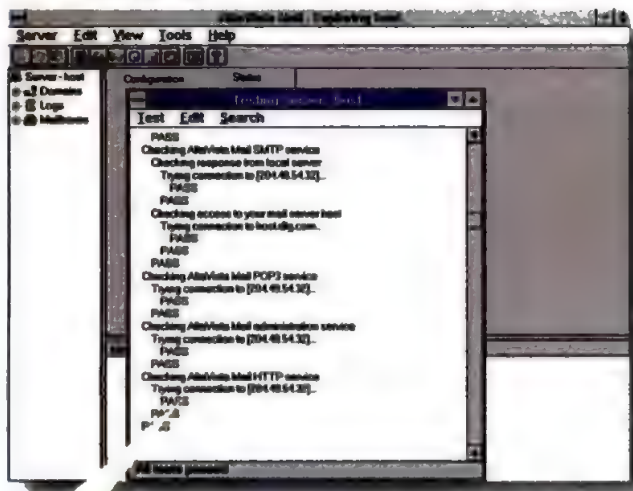
First Looks

password. We could also detect that user's host name, so we could track down any unwanted intruders. AltaVista Mail also works closely with AltaVista Firewall and AltaVista Tunnel, as well as other firewall and tunneling products, to provide further security for your e-mail server.

Many of the messaging bells and whistles found in IMail are not to be found in AltaVista, but the latter offers all you need for most e-mail tasks. It includes a mailing list that allows you to send a common message to multiple members of an e-mail group. You can

Lotus cc:Mail and Microsoft Mail. Digital also plans to offer a list server later in the year.

If you are already using another Digital AltaVista Internet product, AltaVista Mail is probably your best choice for a message server. The product doesn't yet offer the same features and utilities as IMail, but Digital is working on them. Though AltaVista Mail isn't a good choice for a LAN e-mail system that isn't connected to the Internet, it offers some powerful messaging tools that make it worth considering if you are connected.



EASY FIX: You can test your server for connection or configuration problems.

also redirect a user's e-mail to another address, if the user is out of the office.

While it doesn't include an e-mail client, AltaVista Mail works with many popular ones, including Eudora, Microsoft Exchange, and Netscape Navigator. As with IMail, you can use any SMTP- or POP3-compliant e-mail client. We even used the IMail client to connect to our AltaVista Mail server.

Digital has been working on several LAN e-mail gateways and plans to make them available this summer. They will allow you to connect your AltaVista e-mail server to proprietary systems, such as

AltaVista Mail 1.0. List price: \$495. Digital Equipment Corp., Maynard, MA.; 508-493-5111; fax, 508-493-8780; www.dec.com. Circle 951 on reader service card.

Ipswitch Inc.

IMail Server for Windows NT

Everything you could possibly need to set up an Internet or intranet server on your LAN comes with Ipswitch's IMail Server for Windows NT, Version 2.61. With features such as a bundled complementary Windows-based client, basic workgroup utilities, and Whois, Finger, and list servers, IMail should easily handle all of your network electronic messaging needs, even if you don't connect it to the Internet.

Its retail price of \$495, which includes 10 IMail Client for Windows NT licenses and support for unlimited third-party e-mail clients, makes IMail considerably cheaper than other LAN-based systems, such as Microsoft Exchange or Lotus Notes, especially if you have hundreds of users.

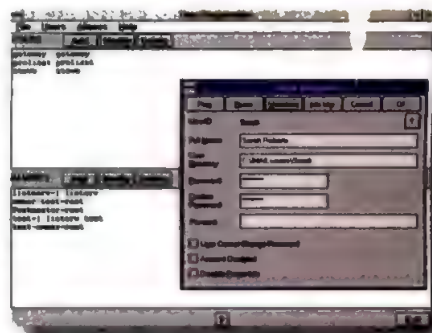
As long as you have the TCP/IP protocol, a DNS (Domain Name Server), or a TCP/IP Hosts file configured on your network, you should have no problem installing the product. The installation routine even determines the host name of your local PC and sets up all the configuration information for you.

After you install the server, simply set up user names and any aliases and you're ready to send and receive messages. And because IMail runs as a Windows NT service, you don't even have to log into the server to use e-mail.

IMail's most powerful utility is the User Manager. In addition to basic tasks, such as setting up users, the User Manager also provides valuable utility functions including

forwarding addresses, rules-based messages, and vacation options. The forwarding address option lets you automatically forward electronic messages sent to a particular address. This is useful if you

MANAGEABLE: The user manager lets you set up user information and security.



want to set up a single e-mail address for your customers to contact your sales staff, for example, so that messages can be forwarded to the proper users.

The rules-based messaging utility allows you to decide where messages go based on settings that you choose. For example, we configured the server to send all messages that contained the word "support" in the subject heading to the proper technical support user on the network. This utility is admittedly complicated

CROSSTALK



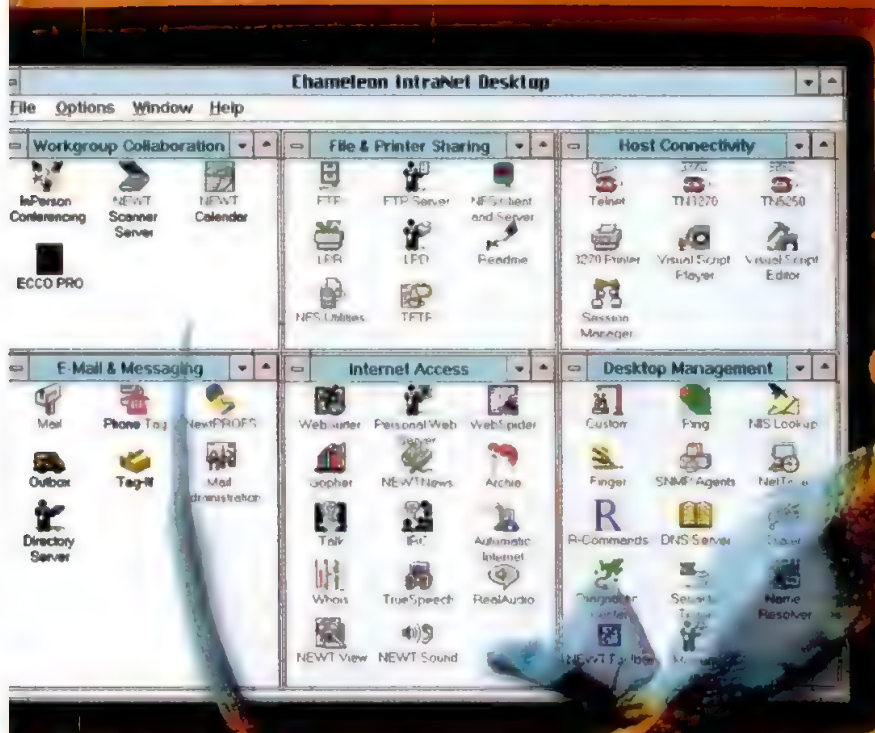
Gail Shaffer

“These two mail systems are just the tip of the Internet messaging iceberg, Frank. People want vendor-independent client programs and a single way to move files and information across their networks. IMAP4 and other internet protocols are challenging vendor-specific protocols such as Microsoft's MAPI.”

“It's more than IMAP, Gail. Despite Novell's backing of NetWare Directory Services, the Internet's Lightweight Directory Access Protocol is likely to win. There will be a 2- to 3-year struggle, but the Internet messaging, directory, and security protocols will prevail.”



Frank Dorfner



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CIRCLE 869 ON READER SERVICE CARD

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First Looks

to navigate, but it doesn't take long to master.

If you've ever gone on vacation without taking your notebook to check your e-mail, you know how frustrating it is to return to a full mailbox. IMail has a solution. You can set up a vacation message that will automatically go to everyone who sends you e-mail. You can also include a forwarding address in the vacation message so a co-worker can handle these messages in your absence.

IMail also works with the MIME (Multipurpose Internet Mail Extensions) specification, so you can send binary, audio, and video files in addition to standard text. You can even set up automatic e-mail replies that will forward a message or binary attachment to anyone who sends

a request to a particular address.

In addition to the powerful messaging utilities in IMail, the product also contains other features to help find and share information including Finger, WhoIs, and list servers. The Finger and

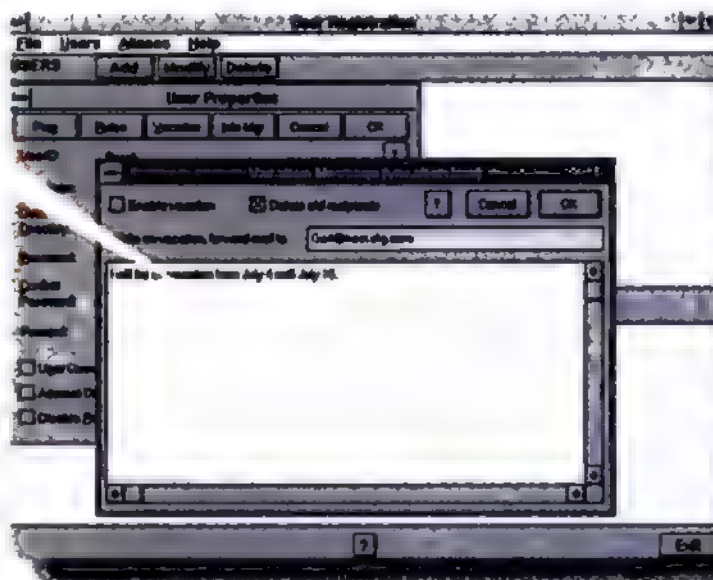
TRY ME LATER:

IMail lets you leave a message when you're away from the office.

WhoIs servers are disabled when you install the product. When enabled, they allow Internet users to get information about any user on your Windows NT server. You can specify what information, if any, is sent back to the curious.

The best way to describe the list server is as a low-end discus-

sion database. In our tests, we set up a discussion topic that was automatically sent to a group of e-mail users. Each user can reply to messages, and the reply is forwarded to all members of the group. And you can



add or remove a user just by sending an e-mail message to the list server.

Although you can use any

SMTP or POP3 e-mail client software to access the IMail server, we were impressed with the bundled IMail client software. It runs on Windows 3.x, Windows for Workgroups, or Windows 95, and it includes features such as automatic mail sorting, separate mailboxes, the ability to send and receive uuencoded messages, and support for URL links in a message. You can even attach a signature file if you want to personalize a message.

IMail Server for Windows NT, Version 2.61. List price: \$495. Ipswitch Inc., Lexington, MA; 617-676-5700; fax, 617-676-5710; www.ipswitch.com. Circle 952 on reader service card.

MULTIPLE ACCESS By Frank Derfler

We Know Who You Are



We know who you are. And we saw what you did

You folks who get *PC Magazine's* Network Edition are a special bunch. You're part of a group of about 300,000 paid subscribers who have, through their interests and responsibilities, qualified to receive what we call NE or NED. During the first half of this year, we reviewed special survey forms from more than 1,000 of you to find out what you do and how you feel about NE. In response, you'll see a few new twists to the coverage in NE. Want to know how you fit in?

Except in two areas—the number of you who are IS professionals and the penetration of Windows NT Server—the results were no surprise. For example, we weren't surprised that 82 percent of you are involved in some aspect of network management. Most of you (66 percent) manage or oversee network policies and procedures.

Neither were we surprised that 64 percent of you are into the Internet way past your elbows. You're busily buying and setting up Internet and intranet servers, applications, and services. We fully recognize your involvement and use our pages in NE to help you plan strategies and architectures instead of teaching you about 10Base-T and modems.

Although most all network administrators have set up small

offices, our NE recipients have an average of 329 network nodes in their business locations. The survey also showed that 61 percent of our readers have their LANs linked with WANs. In NE we're going to tell you more about frame relay and routers than about voice/fax switches and small UPSs. As we've proven, we have the facilities and resources at PC Magazine Labs to test WAN and big LAN systems. And we're going to do more of it for you.

Of our full *PC Magazine* subscriber base, about 43 percent of readers have jobs in an IS or computer-related environment. Among NE recipients, we were happy to find 62 percent of our readers in IS or computer-related jobs—primarily in large companies. Only 27 percent of those surveyed list themselves as independent consultants. We're going to increase our NE coverage of corporate survival skills and strategies for integration with legacy computer systems.

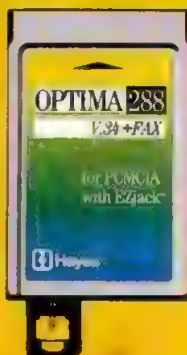
Now in the Wow! department: 17 percent of NE readers have ATM systems installed and 19 percent have Fast Ethernet. Where did all of that ATM come from? We're not sure, but it's certain that you'll see continued coverage of fast networking strategies in our pages. Similarly, our strong coverage of Microsoft Windows NT will continue, because 35 percent of the folks who receive Network Edition have Windows NT Server installed, while 49 percent intend to install it. Although our survey statistics are just about right for NetWare—40 percent have Version 3.x installed and 29 percent have Version 4.x—that's a pretty poor upgrade story for Novell. We need to look into that.

So we'll continue to stay focused on what's important to you, and we hope you'll enjoy the time you spend with *PC Magazine's* Network Edition.



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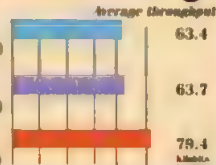
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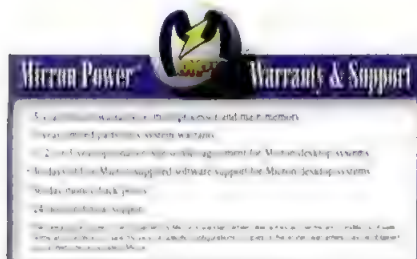
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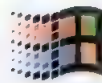
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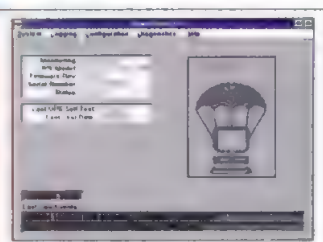
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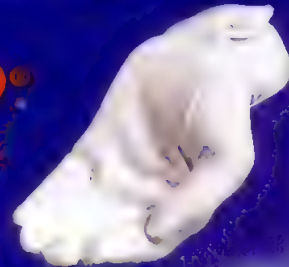
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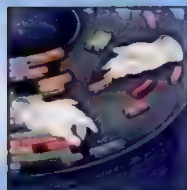
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653	654	655	656	657	658	659	660	661	662	663
664	665	666	667	668	669	670	671	672	673	674
675	676	677	678	679	680	681	682	683	684	685
686	687	688	689	690	691	692	693	694	695	696
697	698	699	700	701	702	703	704	705	706	707
708	709	710	711	712	713	714	715	716	717	718
719	720	721	722	723	724	725	726	727	728	729
730	731	732	733	734	735	736	737	738	739	740
741	742	743	744	745	746	747	748	749	750	751
752	753	754	755	756	757	758	759	760	761	762
763	764	765	766	767	768	769	770	771	772	773
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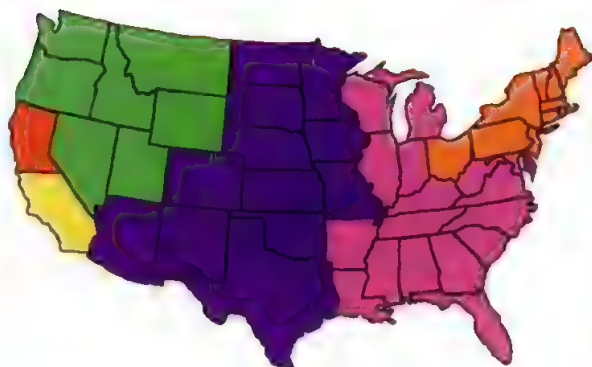
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Head for Your Desktop

By Michael J. Miller

A YEAR AGO, MICROSOFT CORP.'S MARKETING MACHINE used print, television, and the Rolling Stones to push Microsoft Windows 95 into our collective consciousness while IBM Corp. stayed busy hawking the latest version of OS/2 in television commercials that curiously neglected to show its interface.

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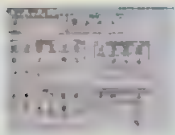
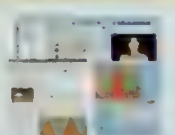
Comparing and Contrasting Today's OSs	102
Sharing the Wealth: DCOM and OSOM	104
Choose Your Processor	109
Will Upgrades Affect Performance and Stability?	110
Microsoft Windows NT 4.0	115
OS/2 Warp 4.0	137



Join us at our Editorial Forum on CompuServe September 9 to 13 to discuss the new versions of Windows NT and OS/2 Warp. Hosts include *PC Magazine* technical director Larry Seltzer, contributing editor Jeff Prosser, and frequent contributor Brian Proffitt.

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Comparing and Contrasting Today's OSs *The operating system*

		Price	Supported installation methods	Memory required	Memory recommended (minimum)	Minimum disk space required	Maximum disk space required	Laptop installation
	Microsoft Windows NT Workstation 4.0	\$319 (street), upgrade, \$149	CD-ROM, network	12MB	16MB	90MB	120MB	N/A
	Microsoft Windows NT 3.51	\$319 (street); upgrade, \$149	Floppy disk, CD-ROM, network	12MB	16MB	75MB	95MB	N/A
	Microsoft Windows 95	\$209 (street); upgrade, \$109	Floppy disk, CD-ROM, network	4MB	12MB	25MB	85MB	25MB
	Microsoft Windows for Workgroups 3.11	\$109 (street); upgrade, \$49	Floppy disk, network	4MB	8MB	20MB	35MB	N/A
	OS/2 Warp 4.0	Info not available at press time	Floppy disk, CD-ROM, network	8MB–12MB	12MB–16MB; 24MB for speech dictation	100MB	300MB	N/A
	OS/2 Warp Connect 3.0	\$145 (street)	Floppy disk, CD-ROM, network	8MB	8MB	80MB	120MB	N/A
	Mac OS 7.53	\$99 (street)	Floppy disk, CD-ROM, network	4MB	8MB	5MB	40MB	5MB

N/A—Not applicable. The product does not have a custom laptop installation

Since then, Windows 95 has become the standard operating system offered to consumers: Microsoft claims some 30 million users. Faceless or not, OS/2 Warp was the most successful version of OS/2 yet, with IBM claiming sales of 7 million. And yet, the dominant OS in the corporate world continues to be... Windows 3.1!

Perhaps that's true because of the long upgrade cycles typical of corporations, or because many corporate PCs don't have the horsepower necessary for more advanced operating systems, or because corporations didn't consider Windows 95 stable enough to handle their mission-critical applications. Most likely, it's some combi-

nation of those factors.

As corporations continue to grapple with upgrade decisions, two newer contenders are appearing on the desktop operating-system horizon: IBM's OS/2 Warp 4.0, code-named "Merlin," and Microsoft Windows NT Workstation 4.0, the latest upgrade of Microsoft's higher-end

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on your desktop is more than just the face behind your applications.

Built-in database connectivity tools	Built-in or bundled Internet tools	Built-in network connectivity	Built-in remote computing tools	Multiple processors	Application interactivity tools or APIs	Built-in multimedia acceleration
ODBC (32 bit)	Internet Explorer 2.0, Peer Web Services (FTP, Gopher, Web), Point to Point Tunneling Protocol, telnet	Banyan, Digital, IBM, Microsoft, Novell, SNA, TCP/IP	Peer Web Services (via browser), Remote Access Services	Yes	OLE, OpenGL, Win32	ActiveMovie, DirectDraw, DirectInput, DirectSound
ODBC (32 bit)	FTP, telnet	Banyan, Digital, IBM, Microsoft, Novell, SNA, TCP/IP	Remote Access Services	Yes	OLE, OpenGL, Win32	None
ODBC (32 bit)	FTP, telnet	Banyan, Microsoft, Novell, TCP/IP	Dial-Up Networking	No	OLE, Win32	ActiveMovie, DirectDraw, DirectInput, DirectSound, Direct 3D
None	None	Banyan, Novell, TCP/IP	None	No	OLE, Win32s	None
None	FTP, Gopher, News-reader/2, telnet, Web Explorer	Artisoft, IBM, Microsoft, Novell, TCP/IP	Remote Access Client	No	Java, OpenDoc, OpenGL, Open32, PM API, Win32s	DART (Direct Audio Routines), full-screen DIVE (Direct Interface Video Extensions)
None	FTP, Gopher, News-reader/2, telnet, Web Explorer	IBM, Microsoft, Novell	LAN Distance Remote, Person to Person	No	PM API, Win32s	320-by-200-pixel DIVE
None	AOL, FTP, Netscape Navigator, newsreader, telnet	Apple	Apple Remote Access Client	No	AppleScript, OpenDoc	QuickTime

operating system. The hype says that Windows NT 4.0 will be the corporate OS of choice. Indeed, it does seem to have many of the features that corporations say they want, combining protection and stability with a modern user interface. But the same can be said of OS/2 Warp 4.0.

To help separate the reality from the hype, this special report takes a close look at preview releases of these desktop operating systems (Windows NT 4.0 was scheduled for release in August and OS/2 Warp 4.0 for early fall), focusing on their features,

design, and underlying architecture. In an upcoming issue we'll look at performance of the shipping versions, which these preview versions closely resemble.

MICROSOFT WINDOWS NT 4.0

Windows NT 4.0's most notable change from previous versions is the addition of the now unmistakable Windows 95 user interface. From the familiar Start button to the Taskbar and the My Computer and Network Neighborhood icons showing your local and network files, this is famil-

iar territory for Windows 95 aficionados. Like Windows 95, Windows NT 4.0 dispenses with the File Manager and uses the Explorer to give you a more detailed tree-based view of your files.

Windows NT 4.0 adds a number of other new features, including support for the Telephony API, DirectDraw, DirectSound, and ActiveMovie. (There is no Direct3D support.) Together with the interface changes, that means many Windows 95 applications will work with Windows NT. But as is often true, the operating sys-

Sharing the Wealth: DCOM and DSOM

By Larry Seltzer

Both Windows NT 4.0 and OS/2 Warp 4.0 have object-orientation facilities built right into the operating system, allowing developers to write *distributed* applications, portions of which can reside on remote servers anywhere on the network.

Object mavens will quibble over their preferred implementations, but Microsoft's Distributed Component Object Model and IBM's Distributed System Object Model basically do the same thing: They allow developers to create objects (packages of data and the operations that can be performed on it) and to have other programs and objects operate on them in a binary-standard manner. The binary-standard part is significant: C++ objects, for

instance, exist only for the program in which they were compiled, whereas DCOM and DSOM objects can be written in any language and can communicate with other such objects, no matter what language they were written in, even if they were written by another vendor.

Compound document systems, such as Microsoft's OLE (Object Linking and Embedding) and IBM's implementations of OpenDoc are built on system object facilities, specifically DCOM and DSOM. Microsoft used to call both the object model and compound document OLE; now, however, OLE is just the compound document API, and the object model is COM. ActiveX is basically synonymous with COM, with some added facilities for

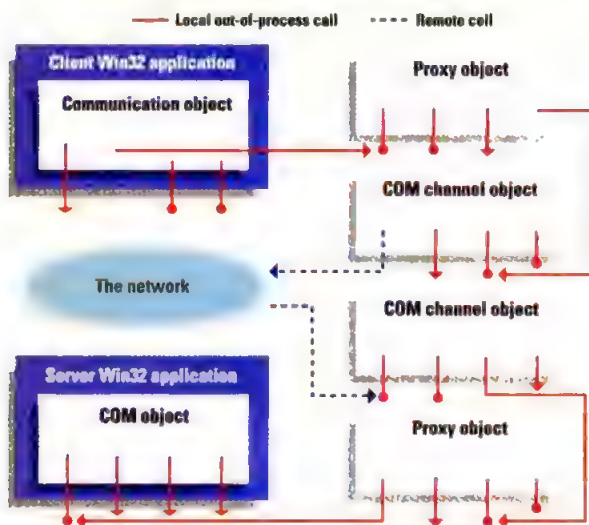
Internet work.

Both Microsoft and IBM use these object facilities to write large parts of their operating systems. Many of the controls in Windows 95 and Windows NT Explorer are COM objects, and much of the OS/2 Workplace Shell is built on SOM. The advantage of this is that developers can write simple programs to use the same controls that are in the operating system and easily modify their behavior.

Microsoft says the Windows NT 4.0 version of DCOM will support Windows NT security. That will allow you to write Windows NT server processes as COM objects. IBM's SOM 3.0, not shipping at press time, will incorporate the security API standards of the Object Management Group (OMG).

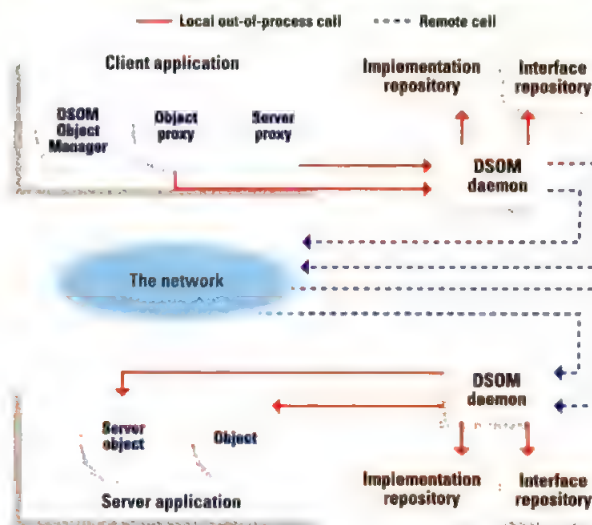
DCOM (Windows NT)

COM objects always talk through proxy objects. In DCOM, the proxy refers the call to a COM channel object.



DSOM (OS/2)

In DSOM, the client application talks through a proxy to the DSOM daemon, which turns it into a remote procedure call over the network.



tems are not perfectly compatible; many developers have reported needing to do more work than they anticipated to make their applications work on both Windows 95 and NT; several applications still don't work, and you may have to reinstall many of your Windows-95 applications if you upgrade to Windows NT.

The new release runs older 32-bit Windows NT applications, 16-bit Windows

applications, and many DOS applications in a DOS window, but its support for older applications and applications that require direct access to the hardware (such as many games) is notably less than Windows 95 or OS/2.

One significant change in the way Windows NT handles applications is its support for the Distributed Component Object Model (DCOM, previously

known as Network OLE), which allows application components to be distributed across a network. This adds the functional equivalent of the Distributed System Object Model (DSOM), which OS/2 has been offering for some time.

From the beginning, Windows NT was designed more for reliability and stability than for performance. On an architectural level, the biggest change in Version 4.0

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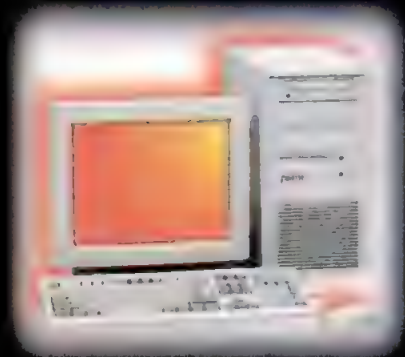
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Choose Your Processor

By Nick Stam

Over the past few months, we've conducted numerous application-based tests stressing Windows 95, Windows NT 3.51, Windows NT 4.0 Beta 2, OS/2 Warp Connect 3.0, and OS/2 Warp 4.0 Beta (known as "Merlin") across a variety of x86-based system platforms. Unfortunately, we cannot directly compare performance for the unreleased products.

We tested on systems ranging from Pentium/133s all the way up to Pentium Pro 200 units, including various Cyrix 6x86-based systems. We ran 32-bit applications under Windows NT including Adobe Photoshop, Autodesk's AutoCAD, Corel Corp.'s CorelDRAW!, Micrografx's Picture Publisher, Microsoft Excel, Microsoft Word, Symantec C++, and portions of our Winstone 32 benchmark tests. For OS/2 we chose two applications: SPG's

ColorWorks, Version 1.0, and VisualAge C++ for OS/2, Version 3.0.

One item we've covered over the past year deserves repeating: The Pentium Pro was designed for true 32-bit applications and operating systems like Windows NT and OS/2. Don't expect to see 16-bit Windows applications perform exceptionally well when running under Windows 3.1, Windows 95, or even Windows NT and OS/2 on a Pentium Pro (measured against a comparably clocked Pentium).

ONE FAST CHIP

Generally, Windows NT and OS/2 applications perform 20 to 30 percent faster on a Pentium Pro than on a comparably clocked Pentium processor. And 32-bit OS/2 applications performed very well on a Pentium Pro versus a Pentium, contrary to popular rumor, which has it that much of the

operating-system code is still 16-bit. We saw significant scaling in performance when running certain ColorWorks filters and compiling code using the VisualAge compiler on a Pentium Pro 150-MHz unit versus a Pentium/166—almost a 40 percent improvement for the Pentium Pro in some cases. Typical Windows 95 applications might perform 10 percent faster on a Pentium Pro compared with a similarly clocked Pentium.

Comparing the operating systems running on Cyrix 6x86-based systems against similar Pentium-based systems showed the Cyrix systems outperforming the Pentium systems on most integer-based operations. But floating-point processing is not Cyrix's strong suit. The Pentium will provide between 20 and 50 percent improvement over the Cyrix 6x86 running floating-point-oriented applications.

may be that, apparently to speed up the OS, some of the graphics controls and other items that used to run as processes on the application level now run in the kernel under the Windows NT Executive.

Several other Windows 95 features have been added to Windows NT 4.0, including a Briefcase for file transfers with a portable computer, an Inbox mail client, a CD-ROM autoplay feature, and dial-up networking, which has been enhanced to allow better use of ISDN lines.

Dial-up networking will help mobile users, but as a whole Windows NT 4.0 isn't optimized for portable users. Though you now can set up multiple profiles for the system to use when docked or not, this OS lacks Windows 95's support for automatic power management and Plug and Play.

Windows NT's new task manager shows you all the applications and processes currently running in your system, which lets you easily end tasks that are misbehaving. It also includes a number of new management features, such as improved diagnostics and systems support.

On the networking side, Windows NT 4.0 adds support for the integration of Internet domain names, and a new version

of client services for NetWare that supports NetWare Directory Services. It also includes Peer-to-Peer Web Services for testing Internet pages or posting personal

*In the latest version,
OS/2's user interface has
been almost completely
revised to give it a more
modern look and feel.*

Web pages, as well as Microsoft Internet Explorer 2.0 (users can upgrade to Version 3.0 of the browser for free).

Windows NT 4.0 continues to offer high-end security for those who need it. It will also be available for Alpha, MIPS, and PowerPC processors.

IBM OS/2 WARP 4.0

The first thing we noticed about OS/2 Warp 4.0 was that the user interface has been almost completely revised to give it a more modern look and feel. The Work-

place Shell, using 256 colors instead of the previous version's 16, includes more three-dimensional icons, changeable backgrounds, and the like.

WarpCenter, a new toolbar for launching files, contributes to a cleaner, more organized overall design. It replaces the LaunchPad in OS/2 Warp 3.0 and gives you a series of menus or folders in "trays." The first level automatically reflects objects on your desktop, and you can add your most frequently used programs. You can also use the trays to navigate through the files on your hard disk.

The biggest change in OS/2 may be the inclusion of IBM's voice-recognition system, VoiceType, which allows for seamless navigation of the OS as well as dictation. Though several other operating systems—notably the Mac OS—have added voice recognition for command and control, the speaker-independent VoiceType seems to work pretty well with a little training. It lets you tell the system to close a window or open a selected application, and it automatically accepts speech links for menu items and controls in the active window's dialog boxes without any special setup, making voice con-

Will Upgrades Affect Performance and Stability?

By Dan Smith and Ben Z. Gottesman

Whenver a new operating system appears (or nearly any piece of software for that matter), users immediately wonder about a possible decline in performance and stability. Microsoft has stated that it intends for Windows NT 4.0 to improve system performance without compromising the operating system's reliability; IBM has not made any such claims about its upgrading to OS/2 Warp 4.0, although clearly it hopes at least to equal the performance of Warp Connect 3.0.

The adoption of the Windows 95 interface in Windows NT 4.0 adds some overhead that might slow performance. In order to combat this, Microsoft moved certain elements of the operating system (such as the GDI subsystem) out of user mode and into the kernel. The company says that Windows NT 4.0's performance should be roughly the same as that of 3.51, although programs such as GDI-intensive applications will likely show significant performance improvements. (See the section that follows on Windows NT 4.0 for more info.)

As most users know, there are often substantial differences in performance between beta software and the final shipping version. Typically the shipping product has improved speed, since often one of the last parts of development is performance tuning and optimization. The opposite situation is not unusual, however (case in

point: Windows 95). We wanted to obtain a rough idea of the performance of both Windows NT 4.0 and OS/2 Warp 4.0 in relation to the prior versions, so we ran some anecdotal tests on prerelease versions of Windows NT 4.0 and OS/2 Warp 4.0.

To test Windows NT, we selected a broad spectrum of 32-bit applications.

These included mainstream productivity applications (Microsoft Word and Microsoft Excel), graphics applications (AutoCAD and the Business Graphics/DTP portions of the Winstone 32 benchmark test suite), and disk- and processor-



The ColorWorks File Rotate test was the only test to show significant performance degradation (at right) moving from OS/2 Warp 3.0 to Merlin beta. This may be attributable to extra debugging code in the beta software.



trol instantly more accessible and practical for users inexperienced in using voice-aware systems.

VoiceType also lets you perform dictation in a special window and then move those results directly into another application. Given current hardware limits, VoiceType's dictation supports only discrete speech, with pauses between words, rather than continuous speech, where you talk as you normally would. Like other voice-recognition systems, VoiceType often recognizes words incorrectly at first "hearing." But you can correct the system, which adapts to your speech patterns and gradually improves upon its accuracy. Still, VoiceType is appropriate mainly for special situations, not daily word processing.

The other significant change is the inclusion of the Java Developers Kit and a run-time code module that allows Java apps to run on the operating system independent of a Web browser. A Java-based stock ticker, for instance, could run in a corner of your screen. The beta version of OS/2 Warp 4.0 included IBM Web Explorer 1.2, a new version of its browser that supports Java. At press time, IBM stated that it had entered negotiations with Netscape to bundle a native version of the Navigator browser with OS/2 Warp 4.0.

Other new features include an integrated version of Lotus Notes Mail, extended to support Internet mail through the POP3 and MIME protocols while retaining Notes 4 features, such as replica-

tion. Help is improved through a new Assistance Center and the WarpGuide, a set of wizards that customize online help. Whereas OS/2 Warp 3.0 came in four major flavors—with or without Windows support and with or without many of the network features—the new version eliminates the confusion by including the Windows 3.1 capabilities and the Warp Connect features in all copies, along with additional networking functionality.

MORE TOOLS

Support for applications has been OS/2's Achilles' heel, but the operating system shows a few encouraging signs, even if OS/2 applications tend not to have the cachet or sales volume of their Windows or



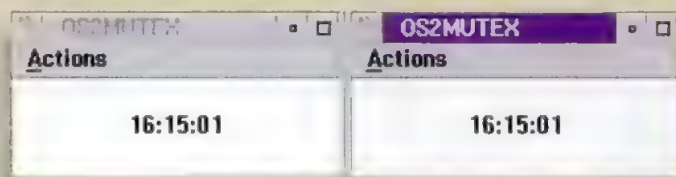
Opening 1,000 windows was no problem for the Windows NT (above) or OS/2 Warp betas.

intensive applications (Symantec C++ Compiler and the Database portion of Winstone 32). Our main test for OS/2 Warp 4.0 used SPG's ColorWorks, a 32-bit multithreaded photo-illustration program. We ran all of our tests on a Micron Pentium 133 and a Reason Pentium Pro 200 at both 32MB and 64MB of RAM.

On Windows NT as well as OS/2 Warp, we saw no significant differences between the current system and the prerelease copies of the newer version. One might be faster than the other on an individual test, but not substantially. The one exception was a file-rotate test in ColorWorks, a very disk-

intensive test, which was much slower under the Warp 4.0 preview. Typically this would point to the operating system's overhead and virtual memory handling. The final shipping product may or may not address these issues.

To test stability and capacity, we also ran several bomb tests, which attempt to overwrite critical memory areas, on both prerelease operating systems. We used the same tests in our September 26, 1995 (page 162), roundup on Windows 3.x, Windows 95, Windows NT 3.51, and OS/2 Warp 3.0. As with OS/2 Warp 3.0, the OS/2 Warp 4.0 prerelease operating system crashed on a test that overwrote a system DLL. In all other tests, the system recovered



Our W16MTX32 Mutex test launches two instances of a clock application that displays the current time in a window.

gracefully from the memory corruption. At least for the situations examined by these tests, the prerelease software did not show any more instability than

prior versions of the software.

Our capacity tests check the number of window objects that you can open at one time. Both operating systems produced 1,600 windows with no resource constraints.

Finally, we ran the W16MTX32 test, which looks at how an application that has focus can affect other running applications and the operating system itself. The test launches two instances of a clock application that displays the current time in a window and updates the display every second. We then start a 10-second block loop in one window from a menu selection and observes its effect on the other window. As with the prior versions, the prerelease version of OS/2 Warp 4.0 had about a 2-second delay in updating the other clock, while the prerelease version of Windows NT 4.0 updated it smoothly.

Because Windows NT 4.0 and OS/2 Warp 4.0 were not shipping at the time of testing, it's impossible to draw firm conclusions here. With tuning, the new versions might end up improving performance. Or, as is some-

times the case, the designers might introduce new code that slows down operation. Changes might also affect the systems' capacity and stability.

Macintosh equivalents. Sources such as the Indelible Blue catalog (www.indelible-blue.com/ib) offer a wide variety of programs, particularly development tools and utilities. IBM aims to improve applications support by including OpenGL libraries, for high-end graphics applications, and the OpenDoc libraries, designed for component applications, as a part of the base operating system.

OS/2 does support Windows 3.1 and Win32s applications, but not native Windows 95 or Windows NT programs. (Unlike Windows 3.1, Windows 95 cannot run inside OS/2 Warp 4.0.) Instead, IBM is supporting Open32, a process designed to make it easier for applications vendors to port their products by creating native OS/2

code versions. The upcoming version of Lotus's WordPro is one example. IBM has also tried to address many of the hardware compatibility issues by including many more device drivers in the base product and by adding Plug and Play support for ISA cards as well as PC Cards.

Architecturally, the major enhancement to OS/2 is an asynchronous message queue, which prevents the operating system from having to wait for a message from a particular application—a situation which, in previous versions, occasionally led to the system hanging.

MAKING A DECISION

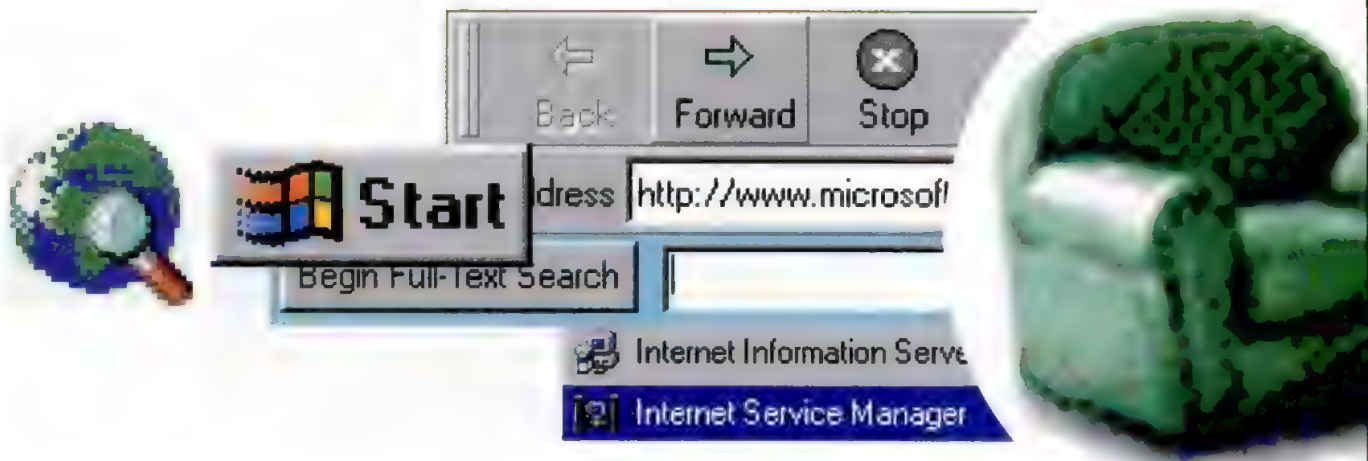
Should Windows NT or OS/2 become your new corporate standard? The an-

swer is yes if you want a greater degree of protection and stability than Windows 95 and better performance on Pentium Pro processors. The price you pay will be slightly higher system requirements and somewhat less hardware support, particularly on laptop computers. OS/2 focuses on native applications while running Windows 3.1 and Win32s applications, while Windows NT provides good but not perfect compatibility with Windows and Windows 95 applications.

In the pages that follow, you'll find more details about these operating systems, which we hope will help you decide whether they meet your computing needs.

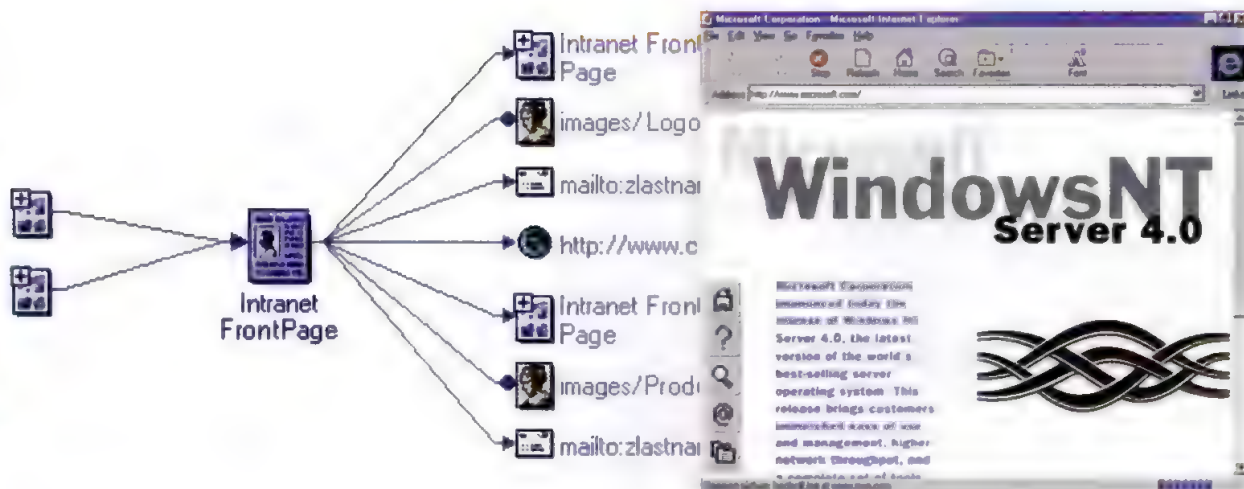
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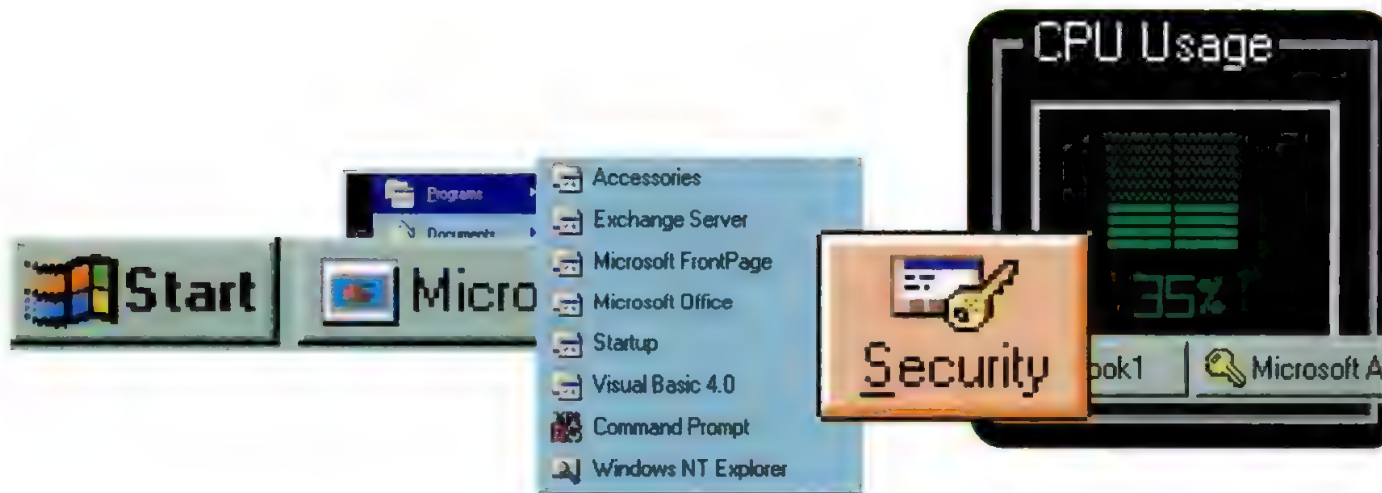
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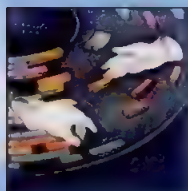
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Windows NT 4.0

It's prettier, but there are more subtle changes that may affect performance and reliability.

By Jeff Proise

THINK ABOUT MICROSOFT CORP.'S WINDOWS NT, AND security, stability, and reliability quickly come to mind. Ask people who use it on a daily basis, and they'll tell you Microsoft Windows NT systems that crash are about as common as 286-based machines running Windows 1.0 are today.

IN THIS SECTION

Finally, a Universal UI for Windows (Almost)	118
Now Windows NT Has More Apps of Its Own.....	132
Are You Being Served?: Windows NT 4.0.....	134

Finally, a Universal UI for Windows (Almost)

By Jeff Prosis

The Windows NT 4.0 user interface (UI) is a near clone of the Windows 95 UI, which has been widely acclaimed for its versatility, ease of learning, and ease of use. But the interfaces aren't quite identical. The Windows NT interface boasts a few features that we'll probably see incorporated into Windows 95 some day. Meanwhile, Windows 95 still has a leg up on Windows NT in certain areas, notably in the way it presents hardware devices to the user.

The screens that follow highlight some of the key differences between the two UIs. Keep in mind that the user interfaces are more alike than different. Learn one of them and you'll feel right at home in the other.

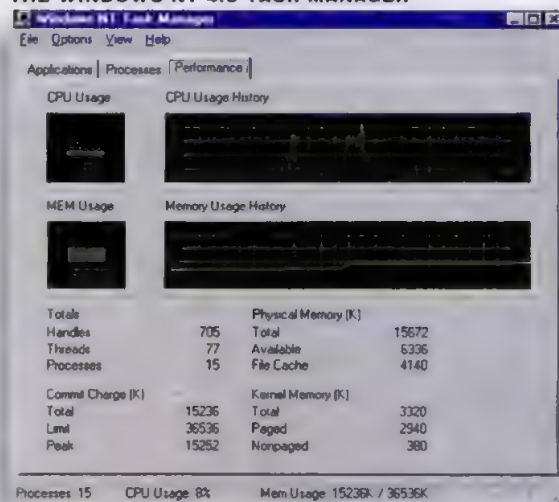
THE WINDOWS 95 DESKTOP



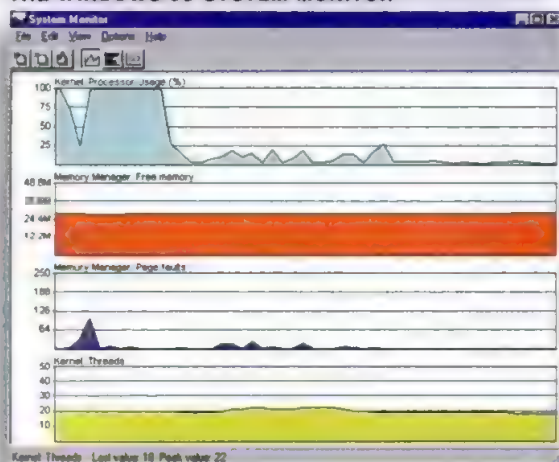
THE WINDOWS NT 4.0 DESKTOP

The Windows NT 4.0 desktop is a perfect replica of the Windows 95 desktop, complete with a taskbar, a Start button, and icons representing objects placed on the desktop.

THE WINDOWS NT 4.0 TASK MANAGER



THE WINDOWS 95 SYSTEM MONITOR



The Windows NT 4.0 taskbar's context menu features a Task Manager command that invokes the Task Manager window shown above. The closest equivalent in Windows 95 is a combination of the Close Program window that pops up when Ctrl-Alt-Del is pressed and the System Monitor utility (shown here) provided on the Windows 95 CD.

It's natural for users to be concerned when fundamental changes are made to Windows NT in order to increase performance and reduce memory requirements. That Windows NT 4.0 is a leaner operating system than its predecessors is an indisputable fact. The question is whether the architectural changes responsible for the improvements threaten to compromise the operating system's legendary re-

liability. Some say Microsoft made a pact with the devil in an effort to fit Windows NT on the desktop. Microsoft insists that Version 4.0 is every bit as reliable as its predecessors and faster, too. So who's right? Is Windows NT 4.0 as stable as previous versions? More important, does upgrading to Version 4.0 pose a risk if your company's mission-critical servers are currently running Windows NT 3.51?

THE OLD WINDOWS NT ARCHITECTURE

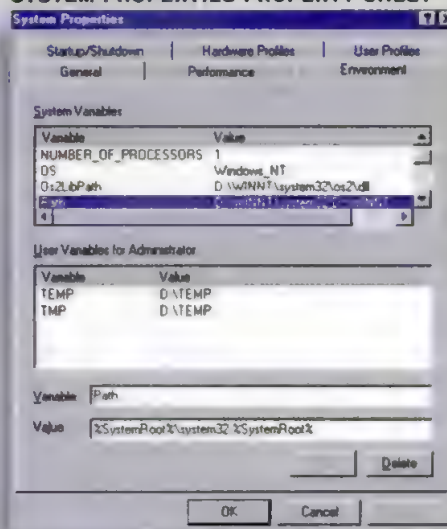
Versions of Windows NT up to and including Version 3.51 use the "modified microkernel" architecture shown in Figure 1 of "Windows NT 4.0: Rebuilt for Speed." Core operating system services used for thread scheduling, multiprocessor synchronization, and other low-level tasks are implemented in the microkernel. Virtual memory management,

The System Properties property sheet displayed by right-clicking My Computer and selecting Properties from the ensuing context menu reflects basic differences in the two operating systems. NT's Environment page allows environment variables to be created without an Autoexec bat file

THE WINDOWS 95 SYSTEM PROPERTIES PROPERTY SHEET



THE WINDOWS NT 4.0 SYSTEM PROPERTIES PROPERTY SHEET

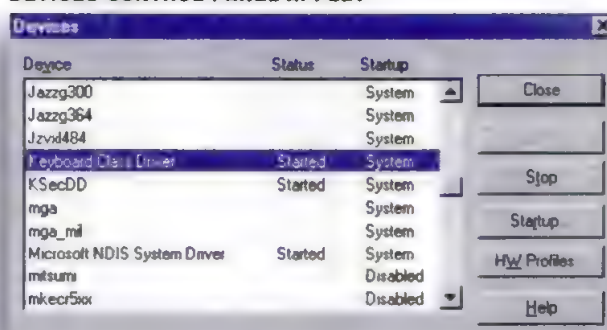


WINDOWS NT 4.0'S PLUS! PROPERTY SHEET PAGE



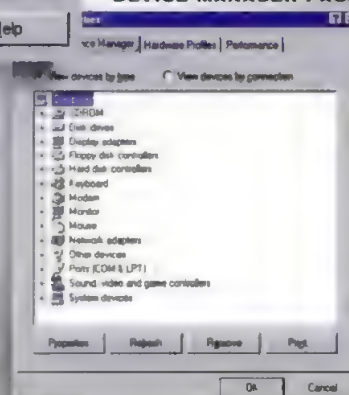
In Windows 95, operating system extras such as options for stretching wallpaper to fit the screen and smoothing screen fonts through antialiasing are sold separately as part of the Microsoft Plus! add-on pack. The same features come for free with Windows NT 4.0 and are controlled through the Plus! page of the Display Properties property sheet.

THE WINDOWS NT 4.0 DEVICES CONTROL PANEL APPLET



Windows 95 presents a concise list of installed devices under System Properties. Windows NT 4.0, by contrast, makes it harder to determine what devices are installed and to query the properties of those devices.

THE WINDOWS 95 DEVICE MANAGER PAGE



process management, and other operating system services are implemented in a separate layer on top of the microkernel, and the microkernel itself is insulated from the physical characteristics of timers, interrupt controllers, and other hardware devices by services in the Hardware Abstraction Layer (HAL). Together, these modules form the Windows NT Executive.

Modern microprocessors allow threads of execution—paths taken through code stored in memory—to run at various privilege levels. Code running at a high privilege level can access data at lower privilege levels, but code running at a low privilege level can't access data in memory marked with higher privilege levels. The NT Executive runs in *kernel mode*, which is the highest privilege level that the

processor offers. On Intel x86 processors, which support four privilege levels referred to as rings 0 through 3, kernel mode is synonymous with ring 0. Applications run in *user mode* (ring 3 on Intel CPUs), so the protection mechanisms built into the processor protect the NT Executive from application programs.

Each application hosted by Windows NT constitutes one process, and each

Windows NT 4.0: Rebuilt for Speed

Windows NT 4.0 isn't just prettier; it's faster too, thanks to subtle architecture changes.

FIGURE 1: Windows NT 3.51

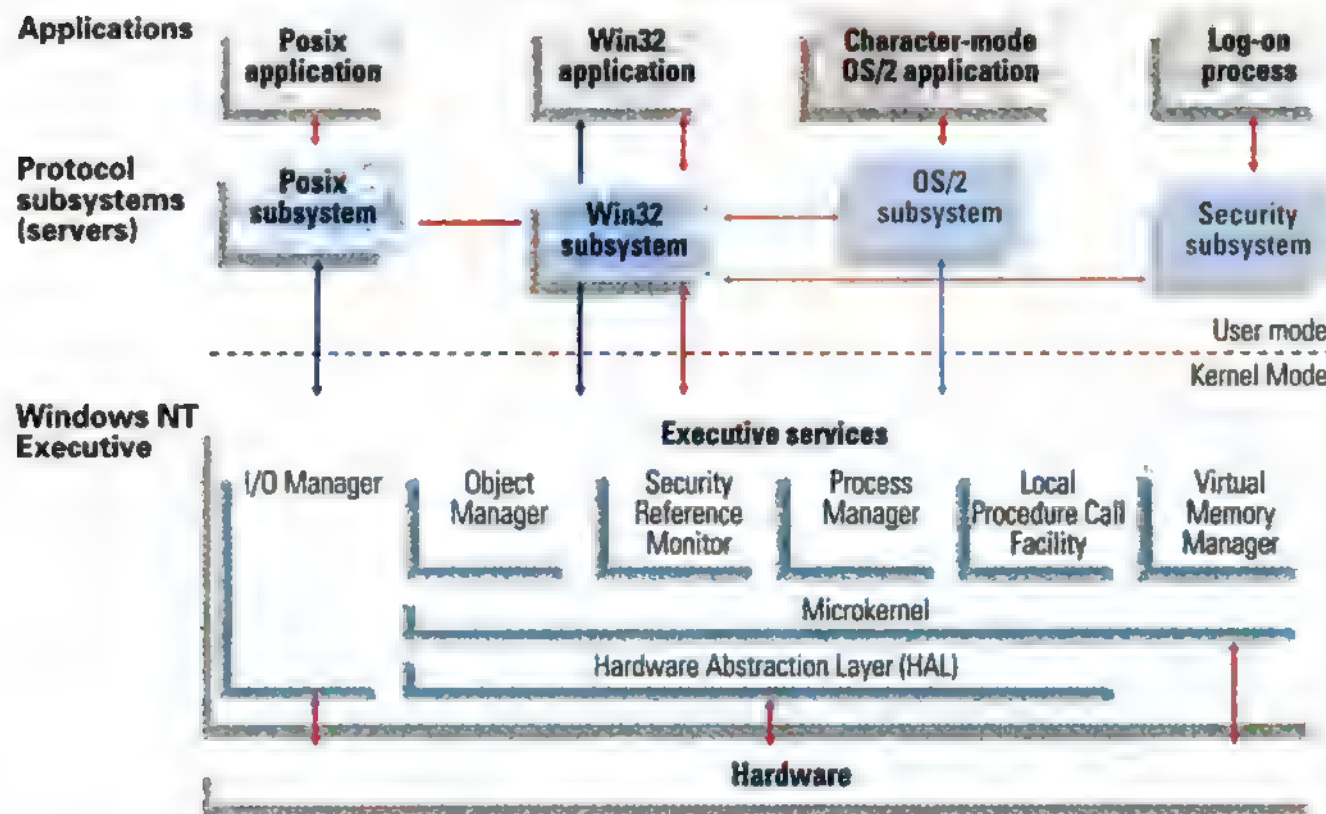


FIGURE 2: Windows NT 4.0

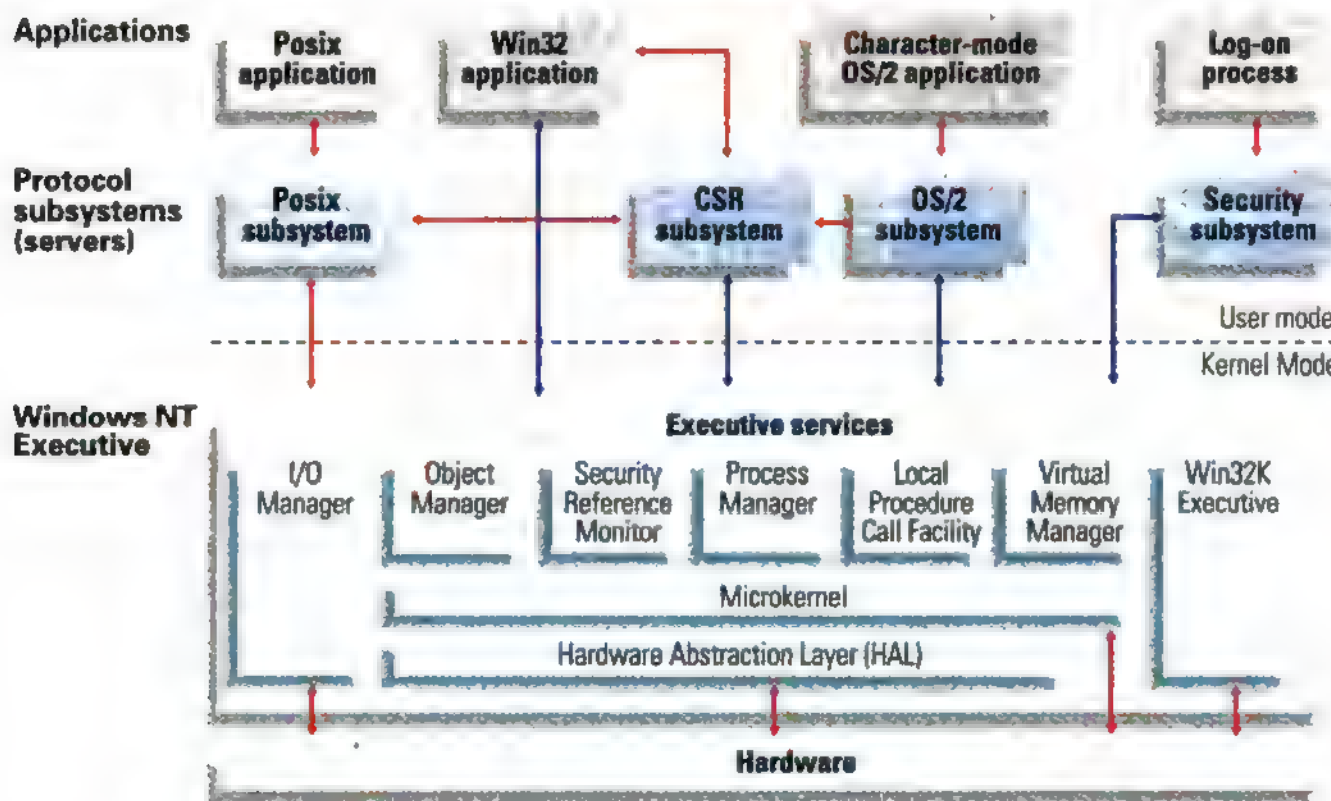
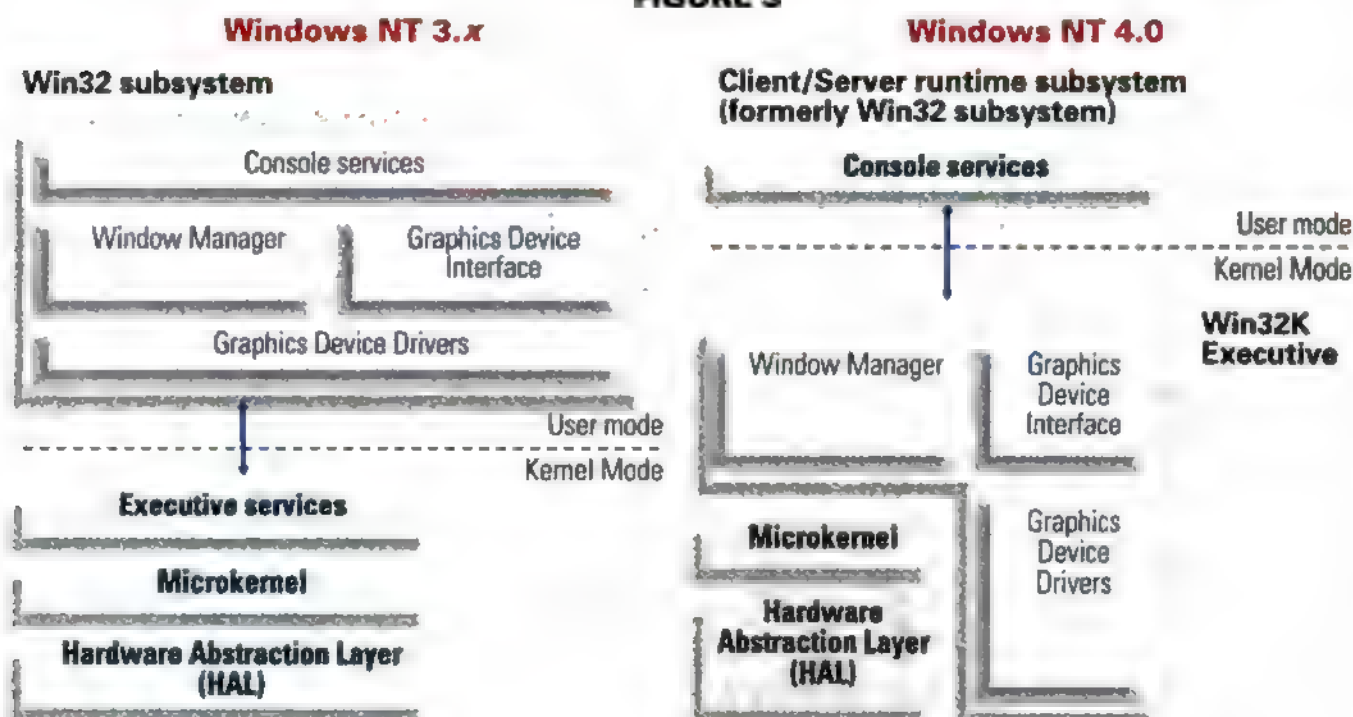


FIGURE 3



process runs in a separate address space where it is physically isolated from other processes. Before transferring control from one process to another, the operating system alters the processor's page tables so that each process sees only its own code and data. It's not possible for one process to access code or data belonging to another process.

One of the most remarkable aspects of Windows NT's architecture is that portions of the operating system—the subsystems—run in user-mode processes alongside application processes. The subsystems provide the environments in which applications run. The Win32 subsystem provides the application program interface (API) services that Win32 applications call to do useful things such as create windows and open files. The Posix and OS/2 subsystems provide similar API services to character-mode Posix and OS/2 applications. (Of course, all OS/2 applications that anyone cares to run are graphical.) Applications and subsystems enjoy a client/server relationship in which the applications are the clients and the subsystems are the servers. One of the benefits of this architecture is that you can include support for other types of applications (Unix applications, for example) to Windows NT simply by adding subsystems.

Much of Windows NT's renowned stability is a direct result of the operating system's architecture. Applications can't interfere with one another because they run in separate address spaces. Operating system code and data in the subsystems is protected from applications because subsystems, too, reside in their own address spaces. The Windows NT Executive shares address space with running processes, but it's protected by the wall between kernel mode and user mode. It's impossible for an application to corrupt code or data stored in the Windows NT Executive because the processor notifies the operating system of or prevents invalid memory accesses before they occur.

Ultimately, an operating system's reliability and resistance to application-induced crashes is a function of how effectively it guards itself and the processes it hosts from other processes. Windows NT excels in this regard because of the high level of protection it provides both to the operating sys-



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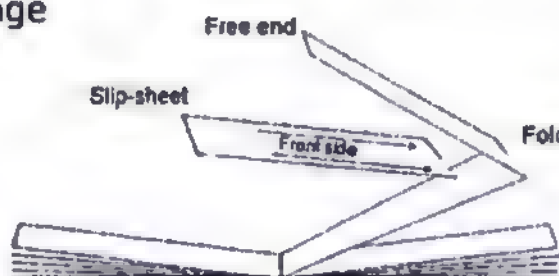
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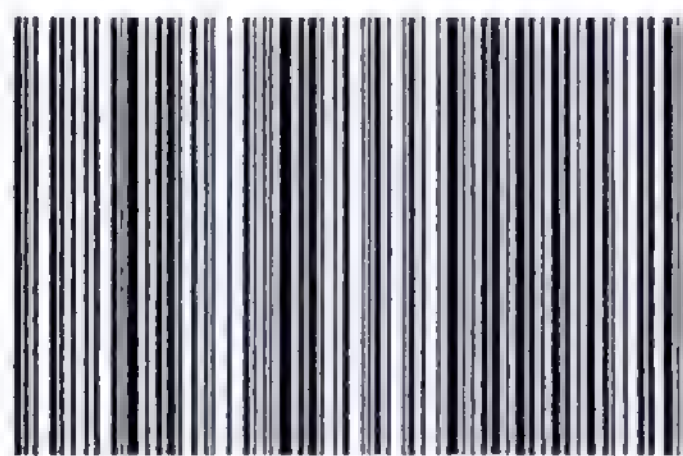
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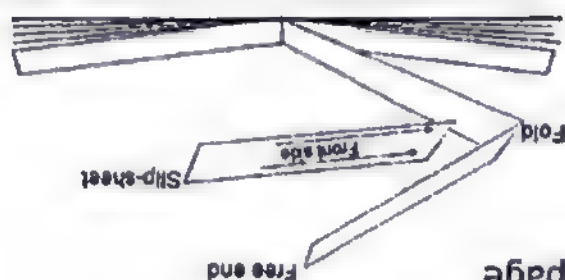
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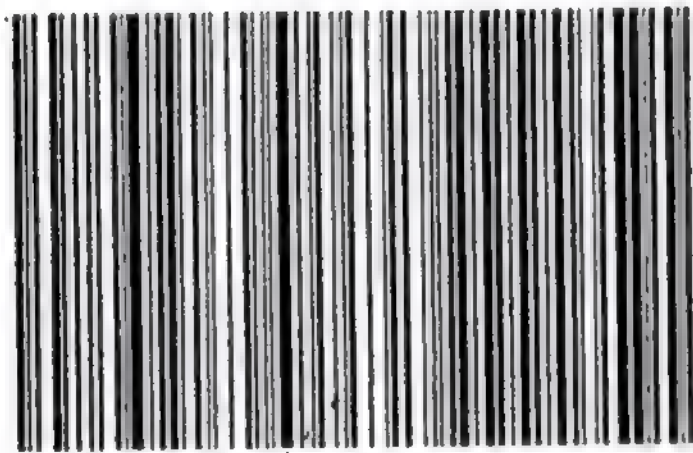
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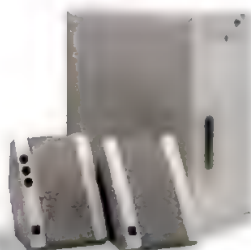
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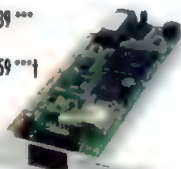
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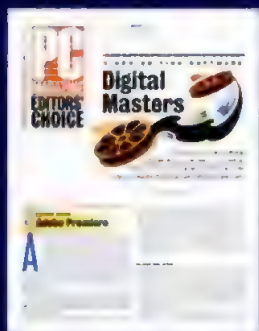
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tem and to its application programs.

But reliability doesn't come for free. When a Windows application calls an API function in the Win32 subsystem (as might happen several hundred times per second), the operating system has to perform a context switch from the calling process to the subsystem process and then back again. Context switches are costly in terms of performance. So are the ring transitions—shifts from one privilege level to another—that are incurred when ring 3 code calls code in ring 0. Ring transitions occur because applications running in user mode use the Windows NT Executive's kernel-mode Local Procedure Call (LPC) Facility to communicate with the subsystems, and also because the subsystems must call into kernel mode to invoke services in the Windows NT Executive.

WHY WINDOWS 95 IS FASTER

Windows NT's architects included a number of optimizations to reduce the number of ring transitions and minimize the impact of context switches. But even at its fastest, Windows NT runs slower than Windows 95, which trades reliability for performance by placing most of its operating system code and data in ring 3, in the same address spaces in which processes run. This increases performance by reducing the overhead associated with API functions (calling an API function requires neither a context switch nor a ring transition), but it compromises reliability by exposing portions of the operating system to applications. Though Windows 95, which runs processes in separate address spaces, is more crashproof than Windows 3.1, a buggy application can still overwrite parts of the operating system, causing a system crash. In Windows NT, an application can crash itself, but it can't bring down the operating system, because it can't access memory containing Windows NT code and data.

Another drawback to placing API services in subsystems that run apart from applications is that extra memory is required to pass data between application processes and subsystem processes. For every application thread that calls a window manager or Graphics Device Interface (GDI) API function, the system creates a matching server thread in the Win32 subsystem as part of a high-perfor-

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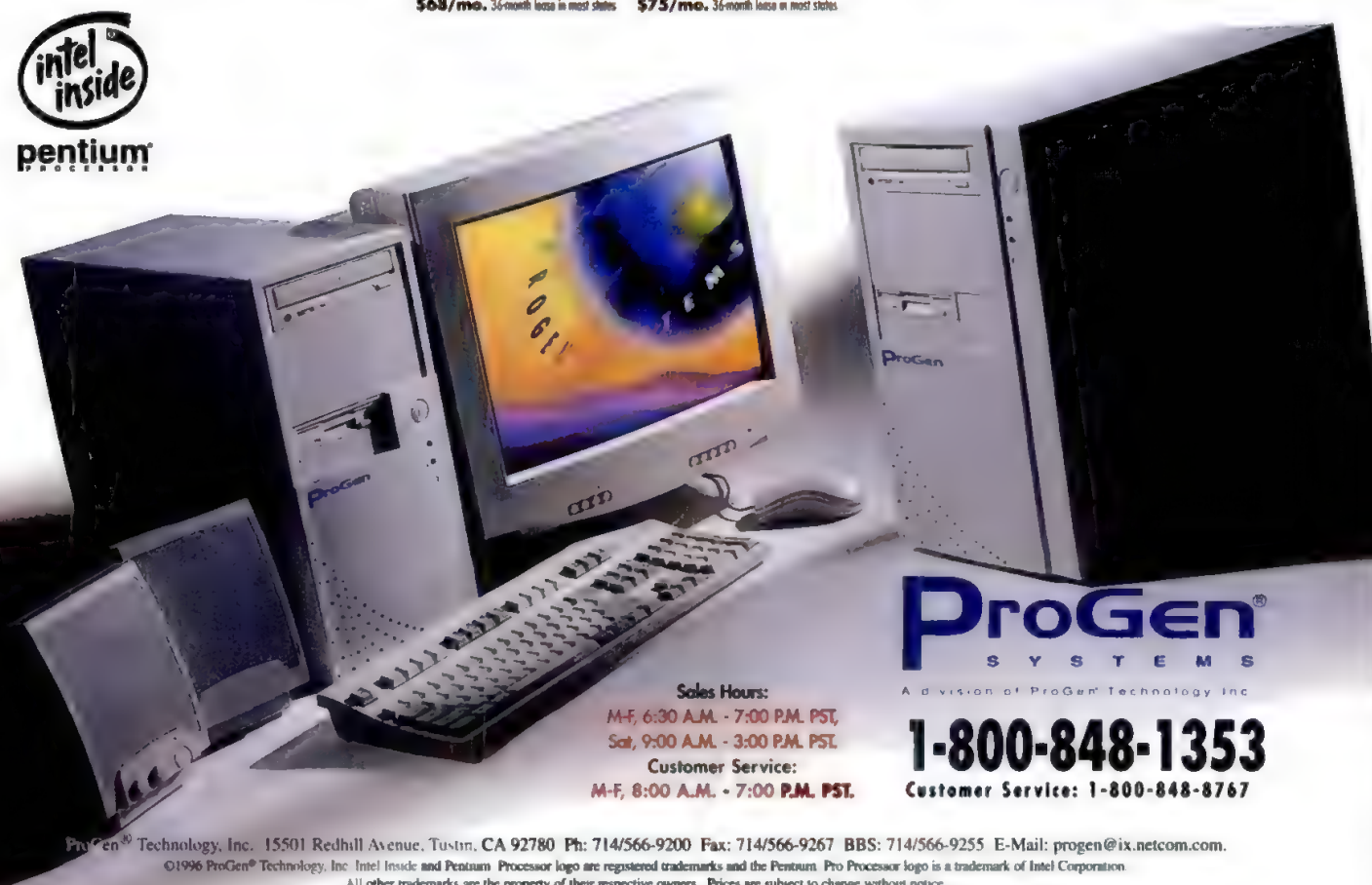
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mance interprocess communication mechanism called Fast LPC. Paired threads boost performance, but they also require memory. To make matters worse, each thread pair is accompanied by a shared memory buffer—a region of memory visible to two processes—that serves as a window for passing data. It's not uncommon for 100 or more server threads to be extant in a Windows NT 3.x system at once, with memory requirements exceeding 1MB. That's one reason Windows NT requires more memory than Windows 95, which neither uses Fast LPC nor requires shared memory for its API functions.

THE NEW WINDOWS NT ARCHITECTURE

In order to boost performance and reduce memory requirements, the designers of Windows NT 4.0 decided to move many of the operating system's API services out of the Win32 subsystem and into the operating system kernel. Figure 2 of "Windows NT 4.0: Rebuilt for Speed" shows the effect on the operating system's archi-

tecture. The new Win32K Executive houses three important elements of the operating system: the window manager, the GDI, and the graphics device drivers that render GDI output on screens and printers. In Windows NT 3.x, these components were part of the Win32 subsystem (see Figure 3 of "Windows NT 4.0: Rebuilt for Speed"). In Windows NT 4.0, they're part of the Windows NT Executive, where, like other kernel-mode services, they can be accessed in the context of calling processes.

The new architecture promises to deliver dramatic increases in performance, particularly in the execution of graphics. All output to the screen is performed through function calls to the GDI. Now that the GDI is part of the kernel, applications can call GDI functions directly and avoid costly context switches, video drivers can get to the hardware more quickly, and Win32 API services can call services in the Windows NT Executive without incurring ring transitions.

Calling GDI and window manager services from a ring 3 application still forces ring transitions, but once again Microsoft has instituted some clever optimizations to maximize performance. One example: If several GDI functions are called in rapid succession, they're queued up in user mode and "batched" to kernel mode as a group to minimize the number of ring transitions. According to Microsoft, the new GDI architecture should allow graphics-intensive applications such as PowerPoint to draw images 15 to 20 percent faster. Though our informal tests with PowerPoint did not support that assertion, we did see improved performance with 3D Pinball, Microsoft's graphically intensive pinball game.

Performance in other areas is improved, too. Moving the window manager to the kernel eliminated a key bottleneck that limited bandwidth between the window manager and application programs that call window manager services.

And what about memory? Now that

Now Windows NT Has More Apps of Its Own



By Edward Mendelson

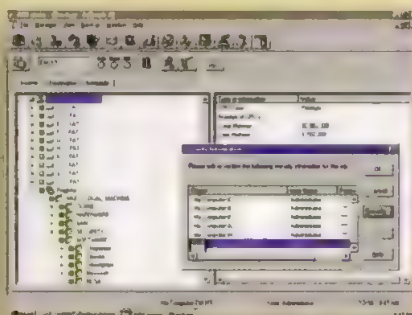
Windows NT 4.0 sports a new interface, but its architecture remains close enough to earlier versions that you won't see the rush of new applications and utilities that appeared with the debut of Windows 95. Also, most apps that run under Windows 95 run equally well under Windows NT 3.51 and 4.0.

For this story, *PC Magazine* surveyed programs available for Windows NT but not other Windows releases. Most of them run under Windows NT 3.51 or later, with a few specific to 4.0.

Windows NT tightly controls direct access to the disk, so Windows NT-specific disk utilities are common.

Diskeeper for Windows NT (for workstation, \$125; for server, \$399) from Executive Software (800-829-6468; www.execsoft.com) defragments NTFS and FAT disks in the background; a new version for 4.0 will use hooks built into the OS instead of replacing system files, as earlier versions did.

Norton NT Tools (\$49.95) from Symantec Corp. (541-334-6054; www.symantec.com) is a thin collection, consisting of a file manager, a system reporting tool that mostly duplicates Windows NT's built-in reporting functions, and a virus scanner.



Cheyenne's ARCserve 6, one of the first Windows NT applications built to match the interface of Version 4.0, includes an option to back up and restore part or all of the Registry.

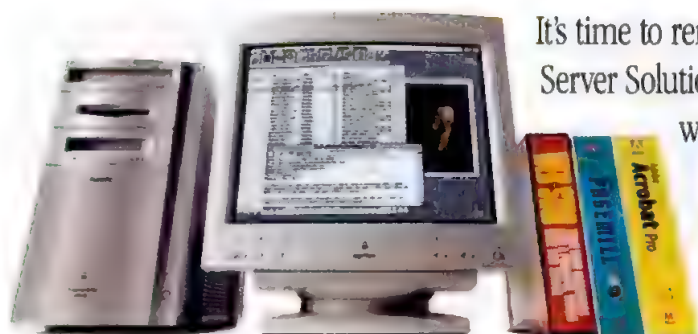
Among Windows NT backup packages, **ARCserve 6** (single server, \$795) from Cheyenne Software (800-243-9462, 516-465-4000; www.cheyenne.com)

has a Windows NT 4.0-style interface and includes a new tape image option that allows a complete restore without reinstalling the operating system. Seagate Software (407-333-7500; www.sssmg.seagate.com) now manufactures **Backup Exec**. The package ranges from \$295 to \$1,295 and takes on a 4.0-style interface in a new version.

Many Windows NT-specific applications hook into Windows NT Server to act as a clearinghouse for incoming and outgoing data. Virtually all Internet server software, including Netscape Commerce Server and O'Reilly's Web-Server, runs under Windows NT, but Microsoft's Internet Information Server, part of Windows NT Server OS, is tightly integrated into the OS.

Windows NT also supports fax server software. Among the new entries is **Zetafax 4.5** (single server, \$150; unlimited site license, \$2,995), from Equisys (770-457-0630; www.equisys.com), which runs as a service under Windows NT and integrates with Microsoft Exchange.

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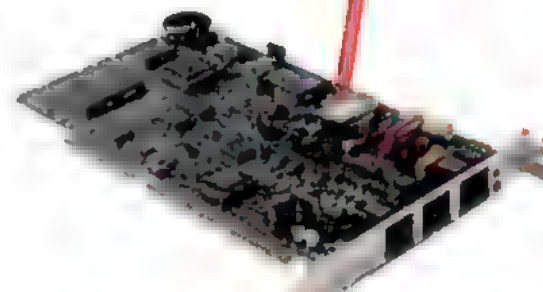
Let's just say light is starting to get jealous.

It's not surprising, considering the Sportster's features: TurboPPP™ provides compression up to 512 Kbps. The onboard analog port lets you connect a standard phone or fax, allowing you to talk or send/receive a fax simultaneously with data transmission.

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"The Screamer"
- *PC Magazine*

U.S. Robotics

ARE YOU BEING SERVED?: WINDOWS NT 4.0



By Steve Rigney

Windows NT 4.0 is a lot more than just a new version of Windows NT with the Windows 95 interface.

With enhanced network features—such as built-in remote access, administrative wizards, network management, support for NDS (NetWare Directory Services), and an Internet server—plus the ability to work with all the major network protocols, including TCP/IP, IPX, and NetBEUI—Windows NT 4.0 is a great tool for any network administrator.

Based on our advance look at the upcoming release, we recommend that network administrators take a close look at Windows NT 4.0 when it ships.

BIG CHANGES

One of the biggest additions to Windows NT Server 4.0 is the Internet Information Server (IIS). IIS includes both a Web server and an FTP server and is a snap to install and even easier

to use. It also adds remote management—necessary for most Internet servers. Windows NT Workstation 4.0 includes Peer Web Services. This is a scaled-down Internet/intranet server based on IIS.

While Windows NT is gaining market share as a network file server, Novell's NetWare is still the most popular. Fortunately, Windows NT 4.0 includes the NDS drivers that let you connect to a NetWare 4.x directory tree, so you can manage all of your NetWare servers and clients from a PC running Windows NT. Windows NT 4.0 also executes your NetWare login script, a feature that has been sorely missing.

The Administrative Wizards are probably the most useful additions to Windows NT 4.0. They can walk you through common network tasks, such as adding a user or printer, or sharing your PC's resources. The wizards ensure that you don't miss an important step that could cost you hours on the phone with technical support.

BETTER CHECKUPS

Windows NT has always had some basic diagnostic and performance-monitoring utilities, but they have been confusing to use and set up. Windows NT 4.0 makes these utilities easier to use and even adds some new ones. The most exciting is the network monitor, which allows you to monitor all traffic in and out of the server. You can filter the information based on protocols to see how much bandwidth is in use and by which users. The new Windows MSD (Microsoft Diagnostics) is similar to the DOS-based MSD we all know, but now it has a graphical interface and lets you troubleshoot PCs remotely across the network.

All of these new network features, plus the ability to work with almost any network protocol, make Windows NT 4.0 a powerful network operating system. Even if you use another product for your file and print services, Windows NT 4.0 is still a good choice for a network administrator's desktop.

the bulk of the code and data implementing the operating system's Win32 API services is mapped into the address of every process, there's no longer a need for server threads and shared memory buffers. Consequently, the system's appetite for memory is reduced. The savings are roughly offset, however, by the enlarged footprint of the user interface shell. So while it's true that Windows NT 4.0 uses memory more efficiently than did Version 3.x, it's also true that you'll still need at least 16MB of RAM to achieve minimally acceptable performance.

RELIABILITY AND SECURITY

The big question that looms over Windows NT 4.0 is what, if any, impact the architectural changes will have on reliability and security. Will improvements made in the name of performance make a Windows NT server or workstation more likely to crash? And will the new architecture diminish the operating system's vaunted security, which allows a properly config-

ured system to comply with the U.S. government's Class C2 security standards?

Only time will tell for sure, but the answer to the question of whether the changes will affect stability is a cautious no. Operating system code moved from the Win32 subsystem to the Windows NT executive is no less protected now than it was before, although it's now protected in a different way. Critics point out that a buggy video or printer driver may now be able to crash the kernel, whereas before it could only crash the Win32 subsystem. Microsoft argues—correctly—that both Windows NT 3.x and 4.0 are only as stable as the device drivers one uses with them. That's why Microsoft tests device drivers for Windows NT, including those written by third parties, and certifies only the ones that pass muster. If the quality of Windows NT 4.0 graphics drivers meets or exceeds the quality of Version 3.x graphics drivers, there's no reason Windows NT 4.0 can't be every bit as reliable as 3.x. On the other hand, installing an uncertified graphics driver in a Windows NT 4.0 system is theoretically

riskier than installing the same driver in a 3.x system, because Windows NT 4.0 graphics drivers operate in the CPU's privileged kernel mode.

As for security, Windows NT 4.0 is built to meet Class C2 security standards, just as its predecessors were. The architectural changes do not affect the security subsystem, which like the other subsystems runs in a separate user-mode process.

The subtle changes to Windows NT's architecture in Version 4.0 reflect a new attitude on the part of its designers. Originally, Windows NT was envisioned to be an "equal opportunity" operating system that could run other operating systems' applications as easily as its own. But now that the Win32 API has assumed center stage, Windows NT has been optimized to run Win32 applications faster than ever before. Windows NT 4.0 performs noticeably faster than its predecessors, and it apparently does so without compromising the qualities that made Windows NT famous. All things considered, its users could hardly ask for more.

OS/2 Warp 4.0

OS/2 Warp 4.0 looks and acts a little friendlier, and the plumbing remains largely unchanged.

By Brian Proffit

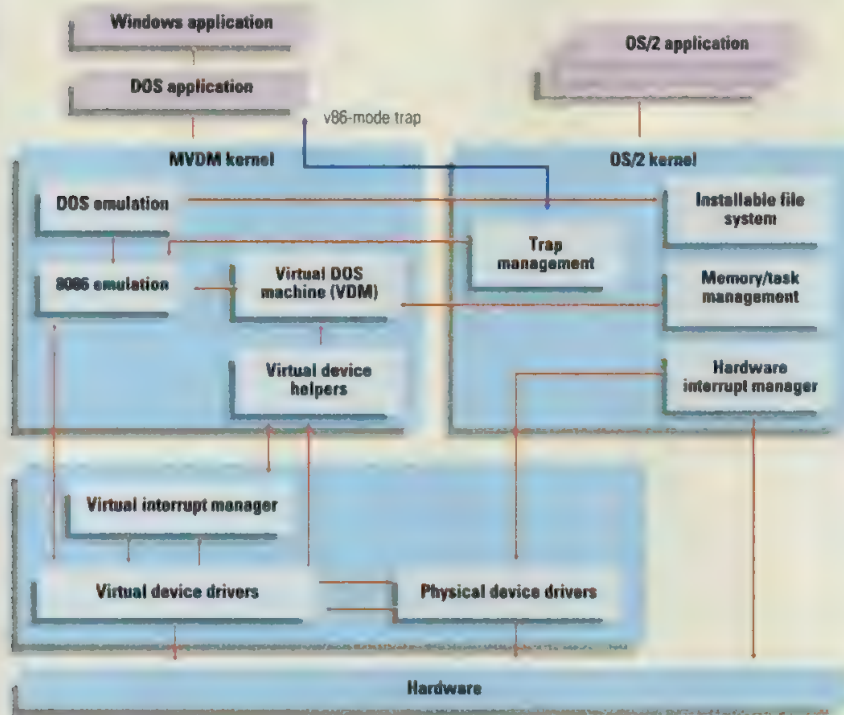
SOME PEOPLE AREN'T ACCUSTOMED TO THINKING OF OS/2 as the more mature operating system, but it actually has a few years' head start over Microsoft Windows NT. Those years have brought a great deal of depth and stability to the base operating system. As a result, the differences in the new OS/2 Warp 4.0

IN THIS SECTION

Taking a Look at the	
Next OS/2.....	139
Why Can't OS/2 and Windows	
Get Along?	142
Warping Applications	143
Are You Being Served?:	
OS/2 Warp 4.0.....	145

OS/2 Warp 4.0: New Face, Same Pipes

The fundamental architecture of OS/2 hasn't changed much. All of the code in the multiple virtual DOS machines (MVM) kernel, OS/2 kernel, and below runs in ring 0, the supervisor mode of the processor. Applications, which run above, are run in ring 3 and in address spaces separate from all the kernel code.



are a matter more of extensive usability improvements and functional additions than of changes to the well-tested kernel. For comparison purposes with Windows NT (see "Windows NT 4.0: Rebuilt for Speed" in the Windows NT section of this story), let's take a look at that base OS/2 architecture.

PORTABILITY VS. PERFORMANCE

OS/2 was born in the days when the Intel architecture was king. In most areas it still is, although new platforms such as the PowerPC and Alpha are making names for themselves as well. But because of that history, the designers of OS/2 focused on performance on the Intel architecture rather than easy portability to other hardware. As a result, there is no underlying microkernel or hardware abstraction layer handling the interface between the operating system and the hardware. That eliminates a lot of code that would otherwise eat up disk space and memory as well as reduce performance.

It's obvious that the designers did a good job of optimizing for Intel, from the

fact that IBM spent many months trying to adapt OS/2 to a microkernel so it would run on the PowerPC before finally throwing in the towel. The bad news is that OS/2 remains an Intel-only operating system. The good news is that it's far faster and requires fewer resources than operating systems with the microkernel overhead.

PERFORMANCE VS. STABILITY

On the other hand, IBM designers valued stability more than performance. In the protection model of Intel microprocessors, programs can run in one of four privilege levels called rings. The most privileged is ring 0, and the least privileged is ring 3. The hardware prevents programs running in less privileged rings from overwriting the contents of memory controlled by more privileged programs. Attempts to do such overwriting are the cause of the infamous Trap 000D or SYS3175 errors that some applications generate under OS/2.

Ring 0 is commonly called *kernel mode* and is where most of OS/2 runs, as well as all device drivers. (It's technically possible

to write certain types of software—specifically, installable file systems—that would run at ring 2, but all software that ships with OS/2 Warp runs in ring 0 or ring 3.) Applications run in ring 3, where they have separate, protected virtual address spaces. From there, they call the operating system services in ring 0. There is some overhead involved in those ring transitions, though. As a result, some operating systems have chosen to execute portions of their code in ring 3 with the applications. This does improve performance, but it also compromises system integrity. OS/2 makes tradeoff decisions similar to Windows 95's; the majority of the operating system, including all of the kernel, runs entirely in ring 0, but some subsystems (in particular, the user interface) run in ring 3 for better performance.

That's why the Workplace Shell has the ability to reboot itself. Running OS/2, at some point you might see all windows and icons disappear from the desktop for a few seconds and then reappear. This means the Workplace Shell has detected a situation in which an application in ring 3 may be attempting to corrupt the video subsystem. To maintain system stability, the Shell reboots itself (with no action from the user required), and all programs and windows usually resume where they left off.

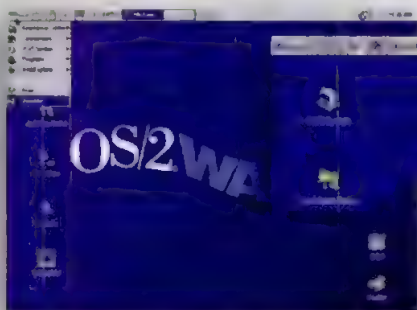
To access the operating-system code running at a more privileged level, applications call OS/2 through a call gate, a special construct in Intel systems that handles such transitions. The memory required is small, usually around 128 bytes, because the application doesn't have to send its data to OS/2. Rather, it sends small pointers to the data; OS/2, as the more privileged program, can use them to access the application's memory directly.

LEGACY PROBLEMS

The main disadvantage of OS/2's heritage is that the platform was written as a 16-bit operating system in the days of the 80286 processor. But since the release of OS/2 2.0 five years ago, IBM has been continually replacing 16-bit code in the kernel with 32-bit code wherever possible, and now there's almost none left. Of course, it isn't possible to convert all of OS/2 to the 32-bit model. To maintain compatibility with older applications, IBM still supports the 16-bit application program interfaces

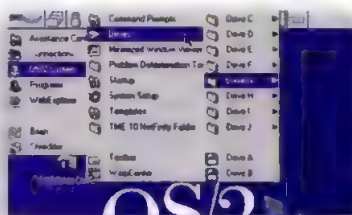
Taking a Look at the Next OS/2

OS/2 4.0 is more attractive and easier to use than its predecessor.



The new WarpCenter gives you convenient access to your applications and avoids the time-consuming process of opening multiple levels of windows just to drill down to the desired program or file

Clicking on the OS/2 Warp button drops down the first level menu. This menu is dynamic. If you move something new onto the OS/2 desktop, this menu is automatically updated to include that new item

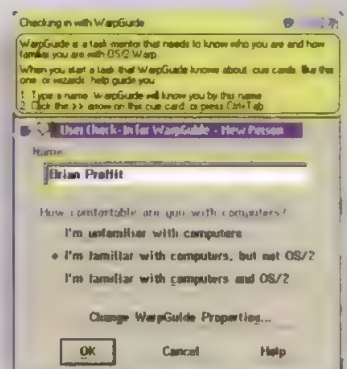


The Drives object in the OS/2 System folder lets you access each drive in your system directly

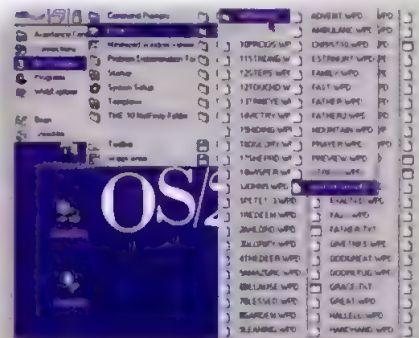


When you find a Web page that you expect to access frequently, you can drag that page onto the desktop

You can also open the Properties Notebook, go to the Speech tab, and create a voice macro for your new object. After recording your "jump-to" word, you can then go directly to the Web page by saying a simple phrase such as "Jump to PCMag's Web site."



As part of OS/2 Warp's friendlier face, the new WarpGuide walks you through numerous system processes, with the level of direction matched to your level of computing expertise.



You can access subdirectories and individual files without going to a command prompt



Dropping the WebExplorer icon onto the tray brings the icon's description up as bubble help text. You can define multiple trays, and clicking on the three-dotted button in the center of WarpCenter lets you switch among your trays.

(APIs). Performance of 16-bit applications, whether OS/2 or Windows, is actually worse in a 32-bit operating system because of the conversions that must take place. The 16-bit addresses they use must be translated into 32-bit addresses, in a process called "thunking," and that takes time. This is noteworthy, because OS/2 Warp 4.0's device drivers and file systems are still 16-bit code.

Even with all this privileged operation in ring 0, there remained a small chink in OS/2's otherwise stable armor. While it was true that one buggy application could not bring down the operating system or other programs, it was still possible for such a program to prevent anything else from running. OS/2 is an event-driven operating system; nothing happens until an event occurs. (Events might include mov-

ing the mouse, pressing a mouse button or a key, receiving an interrupt from a hardware device, or reaching a specific value on an internal timer.) When a user presses a mouse button, the operating system passes a message to the program, which is responsible for processing that message and passing it back.

Sometimes, however, a bug in an application causes it not to clear the message

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Why Can't OS/2 and Windows Get Along?



By Richard Dragan

One of OS/2 Warp's most winning features has always been its ability to run Windows 3.1 programs unchanged, right next to an OS/2 application within the same desktop. But you won't be able to run Windows 95-specific applications on the newest release of OS/2 Warp. Version 4.0 includes the Win32s subset of the Win32 API but not full Win32 support.

tures of Win32, such as OLE support, are just plain difficult to implement because they are not a part of OS/2.

IBM has a proposed solution, though: Open32. It lets software developers quickly port their 32-bit Windows applications into native OS/2 applications. Open32 consists of approximately 800 Win32 APIs and about 300 Windows messages that are built into OS/2 Warp 4.0. Through extensive sampling of millions of lines of Windows source code, IBM chose the most common Win32 functions,

including those used by the most common calls. The Open32 APIs are not emulated functions (which might be slower), but rather another set of APIs that are on a par with standard OS/2 APIs. Both API sets have equal access to the underlying operating system.

The strategy here is to entice developers to maintain a common base of Win32 and Open32-OS/2 code, which could be used to target native 32-bit Windows



A 16-bit Windows application can run on OS/2's desktop.

as well as OS/2 Warp 4.0 applications. First, the good news. You can run Win32s programs unmodified on OS/2 Warp 4.0. The Win32s API specification lets Windows developers build single-threaded 32-bit Windows applications that run on the entire family of Windows operating systems: Windows 95, Windows NT, and even Windows 3.1. But Win32 applications are not welcome on OS/2 Warp 4.0.

The problem, according to IBM, has nothing to do with licensing or performance, but with the innate complexity of the entire Win32 API specification. The Win32 API is truly vast. With its variety of extensions, such as multimedia, MAPI, Telephony API, and Object Linking and Embedding (OLE), Win32 is estimated to include more than 3,000 system calls. Furthermore, certain core fea-

tures of Win32, such as OLE support, are just plain difficult to implement because they are not a part of OS/2.

This model is promising, but there are still a few holes to fill. Developers still wouldn't be able to use OLE in applications, as OLE APIs are not included in Open32. Instead, programs would have to use OpenDoc, IBM's preferred document-sharing mechanism. Significantly, Open32 is geared to porting procedural code and thus won't help programs written in object-oriented languages like C++.

Is Open32 the carrot that entices Windows developers to enter the OS/2 market? Maybe, maybe not. Not surprisingly, IBM's Lotus Development Corp. has taken the first step and is developing an OS/2 version of its SmartSuite desktop suite based on Open32.

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back to OS/2, or at least not to do so very quickly. Previous versions of OS/2 have had a single *synchronous* message queue, meaning a message cannot be processed until the previous one has been completed. (Windows NT has multiple asynchronous message queues.) So if a program stopped handling its message queue, the OS/2 clock icon would show that the system was locked up, and you wouldn't be able to switch to other programs. Pressing Ctrl+Esc might—or might not—cause OS/2 to intervene and let you cancel the offending program, freeing up the system. OS/2 Warp 4.0 changes that. Message handling can now be *asynchronous*, preventing bad programs from locking up the system.

A NEW WAY

A new watchdog thread in the kernel monitors message traffic. A user-adjust-

able timer, also new, determines how long a message can remain unprocessed before the watchdog decides that a program isn't responding. Suppose you've done something in one program that brings up the wait pointer. You move the pointer to another window and click there to do something else while you're waiting. If that click isn't processed within the allotted time period, Warp removes control from the offending program, leaving messages in its queue to notify it of this; Warp then passes the mouse click directly to the new window. This change in message handling greatly improves OS/2's stability, and because the watchdog spends most of its time doing nothing but waiting, it has no measurable impact on system performance.

IBM's attitude toward security is somewhat different from the one Mi-

crosoft adopted when developing Windows NT. IBM doesn't want the base OS/2 Warp 4.0 system to qualify for the government's C2-level security classification. IBM says that the additional overhead would slow down performance unacceptably for those not requiring the extra security. (*PC Magazine* could not confirm this performance impact in other operating systems.) Instead, IBM embedded hooks within Warp so that third-party vendors could develop optional security add-ons that would meet the government's requirements, while the base OS/2 Warp system would remain leaner and faster than otherwise.

EXPANDED APPLICATION SUPPORT

IBM also created an addition to OS/2 Warp 4.0 meant to encourage developers to keep Windows and OS/2 versions of

Warping Applications



By Esther Schindler
OS/2 Warp application developers are busy scrutinizing early builds of the operating system's upcoming release, Version 4.0, to discover what application opportunities lurk within. Here are a few examples of what you can expect to see in the next few months.

Lotus Development Corp. (800-343-5414; www.lotus.com), an IBM subsidiary, has been working on a full upgrade to its **SmartSuite for OS/2** (\$399), due to ship this fall, bringing the feature set up to parity with its Windows offerings. We were encouraged by what we saw in a late preview of Word Pro for OS/2 (which was expected by the end of the summer), with such OS/2-specific features as REXX support and Workplace Shell integration. A new version of Freelance for OS/2 is expected to follow soon after Word Pro.

Another long-awaited OS/2 application suite is the German StarOffice, which StarDivision (402-364-6500; www.stardiv.de) promises to have available in English a couple months after you read this. StarOffice

includes a word processor, spreadsheet, graphics application, and Web browser.

Sundial Systems (310-596-5121), best known for its Relish PIM, is also planning new releases. A new network-ready version of **Relish** will be available by the end of September, along with a new add-on, Relish Web, that will permit access to calendar and phone-book information through a browser. Sundial will also release new versions of the **Clearlook** word processor and the **Mesa 2** spreadsheet product this fall. At press time, pricing was not yet determined.

Cirrus Technology (301-698-1900; www.cirunite.com) is developing **Unite openPage**, a scanning and viewing tool, and **Unite openStore**, a storage management tool used to develop custom-imaging applications. Both are OpenDoc objects.

The next release of **RhinoCom** (\$199), the communication program from Rhintek (800-234-4546; www.rhintek.com), adds features like telnet client and server, caller ID, and fax send and receive.

Stardock Systems (313-453-0328; www.stardock.com) is preparing a product for fourth-quarter shipment called **Plus Pack for OS/2** (price to be determined), which will add desktop enhancements and Internet extensions. A desktop log-on feature will permit users to maintain individual desktops, each with its own



Sundial's new Relish Web will enable users to manage their schedules over the Internet.

environmental variables.

Several vendors are creating or enhancing applications to take advantage of OS/2 Warp's built-in speech recognition. Among them is **Speech Advantage** (703-494-3506); its application, Speech Advantage Office, will make OS/2 word processors easier to use.

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ARE YOU BEING SERVED?: OS/2 WARP 4.0



By Steve Rigney

Like Windows NT 4.0, the new version of OS/2 Warp includes a new interface complete with pop-up menus and a taskbar. The folks at IBM didn't stop there, however. This new release includes powerful network features that allow you to connect to almost any network, dial in from a remote location, surf the Internet, send and receive e-mail, and manage all of your network servers.

OS/2 Warp was, from the start, designed to be a universal network client, and as a result it works with the major network protocols, including TCP/IP, IPX, and NetBIOS. You can use OS/2 Warp to connect to servers running IBM LAN Server, NetWare, and Windows NT. Warp also includes IBM Personal Communications/3270,

which allows you to connect to a mainframe using TCP/IP. Like Windows NT 4.0, OS/2 Warp 4.0 works with both NDS and Bindery databases. The built-in peer-to-peer networking is great if you need to connect multiple desktops together in a workgroup environment.

NOTES MAIL AND MORE

If you use Lotus Notes on your network, you'll like OS/2 Warp 4.0's built-in Notes Mail 4.0. The Notes client includes a full-text editor and allows you to send and receive messages and binary attachments from a remote location or across your LAN. It also works with the Post Office Protocol3 (POP3) and Multipurpose Internet Mail Extension (MIME) protocols, which allows you to send and receive all of your Internet and local e-mail from the same application.

OS/2 Warp 4.0 also includes a remote node client that allows you to connect to a host network using multiple network protocols. The OS/2 client provides strong security, including encrypted passwords and a callback feature. Mobile File Synch is another nice utility. It synchronizes the contents of two directories—a great way to merge the data on your desktop PC with the data on your notebook.

Unlike Windows NT 4.0, the new OS/2 Warp doesn't include an Internet server, but it does have a built-in Web browser and FTP client. The Web browser allows you to surf the Internet or connect to your company's intranet, and the FTP client allows you to drag and drop files between your local hard disk and remote FTP server. These utilities, coupled with the Notes e-mail client, should fulfill most of your Internet or intranet needs.

their products at the same level. The Open32 API (previously called Developer Application Extensions) is an interface that lets programmers write one set of code, which can be compiled and linked with the appropriate headers and libraries to generate either Windows or OS/2 executable programs. (See the sidebar "Why Can't OS/2 and Windows Get Along?")

OPENING UP

Another addition to OS/2 Warp 4.0 is support for OpenDoc. Conceptually, you can think of OpenDoc as a superset of OLE. It allows developers and users alike to mix functions of separate applications together, simply by dragging and dropping the desired parts. OpenDoc is a cross-platform framework, with versions for AIX, Mac OS, and Windows 95 and NT (in beta). OpenDoc should allow developers to get new products to market more quickly, through consolidating functional sections of code into discrete parts. Even more intriguing is the possibility that users can create their own custom applications, by dragging appropriate parts from separate programs and dropping them into a new

OpenDoc container program.

Two other interface extensions are OpenGL, the cross-platform graphics language, and Speech Recognition API (SRAPI). Knowing that the base operating system supports the SRAPI may

Priorities such as performance, stability, portability, and application support have determined OS/2 Warp 4.0's capabilities and produced a stable, full-function OS.

prove to be all the incentive developers need to begin moving their applications to speech access.

OS/2 has a long tradition of superior support for applications of multiple types. The ability to run DOS programs, 16-bit and 32-bit Windows programs (written to

the Win32s or now Open32 interfaces), and 16-bit and 32-bit OS/2 programs has let OS/2 run a wide variety of applications. But some pesky DOS programs still refused to run under OS/2. Version 4.0 includes a new feature called True Mode. Available only on systems where OS/2 Warp is installed on top of DOS, True Mode gives OS/2 the ability to write the contents of memory to disk automatically, boot native DOS to run a desired program, and then reload memory from the disk file so OS/2 can resume exactly where it left off.

A SERIES OF TRADE-OFFS

An operating system is essentially the product of a series of design decisions. Priorities such as performance, stability, portability, and application support have determined OS/2 Warp 4.0's capabilities and produced a stable, full-function, preemptive multitasking operating system that can run acceptably on a 12MB 486. (But 16MB is a more reasonable minimum, and you'll want 24MB and a Pentium/90 for speech dictation.) All in all, it appears that IBM's tradeoffs will work out quite nicely indeed. □

Pentium Pro PCs:



ILLUSTRATION BY DOUGLAS FRASER

POWER TO THE PEOPLE



Thought the Pentium Pro was too expensive? Think again. PC Labs tests 45 Pentium Pro/200 PCs running Windows NT 3.51.

By Carol Venezia

Intel's top dog has reached an intriguing stage in its short life. The Pentium Pro, Intel's sixth-generation CPU, is the vendor's most potent and complex so far, able to handle nearly any demanding 32-bit application you can dish out. But aggressive new pricing structures from both Intel and system vendors are resulting in a generation of powerful, cutting-edge PCs that are affordable. In a mainstream business environment, buying PCs that are a generation behind the power curve makes little sense, because newer and better PCs cost only marginally more.

PRICES DROP ALL AROUND

The Pentium Pro, since it began shipping in November 1995, has seen three price cuts (as Intel releases new pricing quarterly). Pricing (per unit in lots of 1,000) of the 200-MHz Pentium Pro CPU with 256K of L2 cache has dropped nearly 60 percent, from \$1,325 to \$562—and that's in less than a year. This is even more dramatic when compared with the first-year pricing history of the Pentium classic. The Pentium/66 debuted in March 1993 at \$964; in April 1994 its price was \$750, a decrease of only 22 percent.

These price cuts show in the machines we tested. The average system price for this roundup was about \$3,800, with \$2,700 at the low end and \$5,000-plus at the high end. No system, however, was priced at more than \$6,000.

Not just the CPU is coming down in price, either; prices for system memory and hard disks are also dropping. Unlike a few months ago, you can now buy RAM for as little as \$15 per megabyte (at the time you purchase the system); hard disk prices have plummeted to about 20 cents per megabyte, so that the 2GB disks in most of these 45 reviewed PCs account for less than \$400 of the overall price.

IN THIS REVIEW

Aberdeen Inc.158	DirectWave Inc.177	Micron Electronics Inc.193	Unisys PC Division.....204
Acer America Corp.158	DTK Computer Inc.177	Mitsuba Corp.194	Unitex Technology Inc.204
ACMA Computers Inc.160	EPS Technologies Inc.177	Multiwave Technology Inc.194	Vektron204
ACW (All Computer Warehouse)....160	Everex Systems Inc.178	NEC Technologies Inc.194	Xi Computer Corp.205
Advanced Logic Research Inc.160	First Computer Systems Inc.178	Polywell Computers Inc.197	Zenon Technology Inc.205
American MultiSystems Inc.164	Gateway 2000 Inc.183	ProGen Systems198	Editors' Choice149
AST Computer.....164	Hertz Computer Corp.183	Quantex Microsystems198	Pentium Pro Beats Classic
Brysis Data Inc.172	Hewlett Rand Corp.183	Reason Technology Inc.198	at 32 Bits155
Caliber Computer Corp.172	Hewlett-Packard Co.184	Robotech Inc.199	Price/Performance Index157
Comtrade Electronic Inc.174	HiQuality Computer Systems.....185	SAG Electronics199	Performance Tests166
CyberMax Computer Inc.174	Maximus Computers Inc.188	Sys Technology Inc.202	Summary of Features184
Dell Computer Corp.176	Mega Computer Systems189	Tagram System Corp.202	MMX and AGP:
Diamond Technologies Inc.176	Micro Express.....192	Total Peripherals Inc.202	Bridging the Video Gap196

Another compelling reason to purchase a Pentium Pro PC is the much-awaited arrival of Windows NT Workstation 4.0. Not only will that platform acquire Windows 95's user-friendly interface, it will also provide better video support through the addition of ActiveMovie, DirectDraw, and DirectSound. Add these features to Windows NT's virtually crash-proof design, and you'll understand why market researcher Dataquest expects shipments of Windows NT Workstation to triple in 1997 over 1996 figures.

REVIEW CRITERIA

For this roundup, we asked vendors to send systems with the 200-MHz, 256K-L2 cache

version of the Pentium Pro, geared toward mainstream business applications. That is, we wanted desktops, not technical workstations. We did not allow vendors to send machines with the 512K-cache version of the Pentium Pro for two reasons: First, Intel is marketing that version for use in servers, and second, we wanted to focus on affordable systems. (The 200-MHz 512K-L2 CPU is currently about \$500 more per part than the equivalent 256K-L2 CPU.)

We asked vendors to preinstall Windows NT Workstation 3.51 on hard disks with capabilities ranging from 1.6 to 2.5GB, formatted with NT File System (NTFS). We also required systems to have 32MB of RAM, quad-speed or faster CD-

ROM drives, 16-bit sound, SVGA-capable graphics cards with at least 2MB of memory, and 17-inch monitors.

This filter netted us 45 machines from 44 vendors. We allowed vendors to send us two PCs if they had a second unit from a different business-oriented product line that used a different motherboard. Dell Computer Corp. submitted both a Dimension XPS Pro200n, its power-user PC, and an OptiPlex GXPro 200, a strictly corporate PC.

Several major vendors were unable to meet our deadline but should have Pentium Pro/200-based corporate PCs by the time you read this. These vendors include Compaq Computer Corp. (the

HIGHLIGHTS

200-MHz Pentium Pro PCs

No longer are the most powerful PCs relegated to niche markets. With prices averaging just over \$3,800—and 17 machines priced under \$3,500—this crop of 45 200-MHz Pentium Pro PCs prove that top-level processing power is within reach of virtually every desktop.



Hard disk capabilities make a significant difference in the performance of most 32-bit applications, especially with RAM levels below 64MB. This roundup's fastest

systems had SCSI disks with 7,200-rpm rotational speeds. Caching disk controllers can also boost performance: Compared with units without disk cache, Winstone 32 scores improved by up to 7 percent for 16MB of controller cache and up to 15 percent for 64MB. These benefits come at a cost, however: about \$100 for

a 16MB caching disk controller and \$300 to \$1,000 or more for a 64MB board.



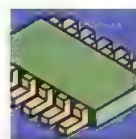
Video playback was not the strong suit of this test group.

Virtually all the machines dropped a large number of frames on our video playback tests. The culprits?

Windows NT 3.51, which does not handle video efficiently (a problem fixed in the coming 4.0 release), and drivers that haven't been optimized.

Performance varied widely in this group of Pentium Pro/200 PCs. On our Winstone 32 benchmark test, the highest score (174, posted by the Zenon Optima Pro Station) was 64 percent higher than the lowest (106, gamered by the Vektron Optima Pro Station). These scores prove that top-rated components and thorough

system optimization are essential to wringing the most performance out of a Pentium Pro PC.



Intel's Natoma chip set made its mainstream debut in 28 of this roundup's 45 systems. The new three-chip design boasts support for Universal Serial Bus,

up to 1GB of EDO or burst EDO DRAM and includes concurrent PCI.

Missing: MIF browsers. Although 15 of this roundup's 45 systems were DMI-compliant, only two units came with a MIF (management information file), which contains a PC's vital statistics. We hope that in the future, hardware and software products will include at least a data-only MIF so that DMI can fulfill its promise of making network management easier.

Deskpro 2000, 4000, and 6000 series), Digital Equipment Corp. (the Celebris XL Pro), and IBM PC Co. (the IBM PC Series 300).

NEW CHIP SET: NATOMA

In the market for core-logic chip sets for Pentium PCs, Intel dominates, although there have always been challengers for market share, including VLSI, Silicon Integrated Systems (SiS), and ALi (Acer Labs). Intel still has no competition in the Pentium Pro chip set market, even months after the CPU's introduction. SiS, however, is preparing to introduce a single-chip core-logic solution for the Pentium Pro, code-named Archer, which will be in the early stages of production by the end of the year.

In our first Pentium Pro PC roundup at the beginning of this year, all machines used Intel's 450KX or 450GX PCIset core-logic chip sets, collectively code-named Orion. This time around, 17 of the 45 systems came equipped with Orion, but 28 used Intel's new 440FX PCIset, code-named Natoma. This second-generation Pentium Pro chip set not only brings significant performance enhancements to the table but also lowers system costs and supports new technologies.

Natoma has three chips, in contrast to Orion's seven. It is a tightly integrated solution that works well with compact system designs implemented on either ATX or Baby-AT motherboards. The Baby-AT design has long been the standard, but the ATX design—a four-layer board that rotates within the PC's case to provide clear access to memory and expansion slots—is gaining popularity. Four-layer boards are cheaper and easier to manufacture than the seven- and eight-layer boards used with early Pentium Pro designs.

Intel's newest chip set supports the Universal Serial Bus and up to 1GB of EDO or burst EDO DRAM, as well as standard fast-page-mode (FPM) DRAM. (The KX version of Orion supports only 512MB of standard DRAM, and Intel will soon phase it out; the GX version supports up to 1GB of FPM DRAM, and Intel will still market it for use in servers.) Natoma also supports error correction code (ECC) memory through its integrated ECC memory controller—a must-have feature for high-end machines.

NEC PowerMate Pro 2200 SAG STA Pro 200 Desktop

This roundup of 45 200-MHz Pentium Pro PCs proves that *affordable power* is no oxymoron. Now you can outfit your company with systems that can ably handle

32-bit applications without breaking the bank. Whether you want the support that a large vendor can provide or are willing to sacrifice some of it for great performance at a lower price, one of our two Editors' Choices will meet your needs.

Our first Editors' Choice is the \$3,471 PowerMate Pro 2200 from NEC Technologies. This machine is chock-full of features that make it easy to set up and maintain on your LAN. The PowerMate Pro 2200 is one of only 12 here that are DMI-compliant, and it's one of only two that provide a MIF browser for Windows NT.

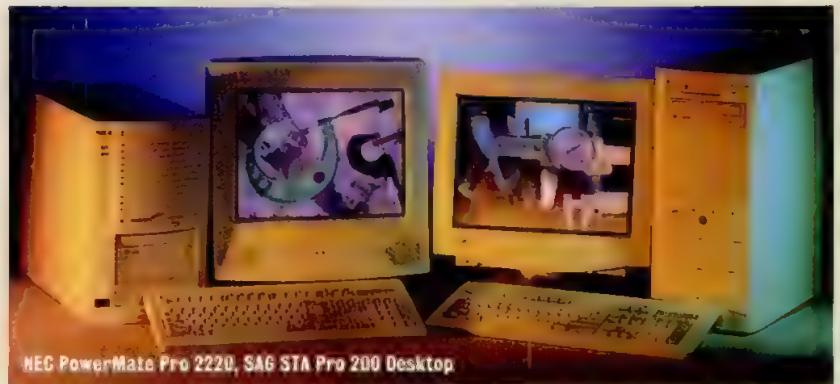
The PowerMate Pro includes Intel's LANdesk and HealthMeter and CyberMedia's First Aid to monitor system resources. It also includes MagicEye's security technology, which detects and reports through DMI when someone opens the PC's case, as



well as monitoring system voltage and temperature. In addition, the vendor offers toll-free technical support lines for corporate customers.

Our second Editors' Choice, SAG Electronics' \$2,999 SAG STA Pro 200 Desktop, is a performance powerhouse. It runs on an AMI motherboard, featuring Intel's Natoma chip set and EDO DRAM. The unit's performance is bolstered by a 2MB Matrox graphics accelerator and a 2GB Fast/Wide SCSI-2 hard disk hooked to an Adaptec 2940UW ultra-wide disk controller.

This hardware paid off on our tests, in which the STA Pro 200 produced the roundup's second-highest Winstone 32 score and well-above-average scores on both Photoshop measures. Toll-free technical support and 24-hour parts replacement augment a two-year parts-and-labor warranty.



Furthermore, Natoma has the option to support two processors in a symmetric multiprocessing (SMP) configuration through the implementation of a stand-alone APIC (advanced programmable interrupt controller). Of the 45 units that we tested for this roundup, however, only 10 used motherboards with a second CPU socket. Surprisingly, Intel manufac-

tured none of those boards. Intel does not mass-market a dual-CPU motherboard for desktops, and it has no plans to do so in the immediate future.

CONCURRENT PCI = BETTER MULTIMEDIA?

The Natoma chip set uses Intel's Concurrent PCI Architecture, which, according to the vendor, enables better video and

audio performance. The feature makes CPU, PCI, and ISA transactions more efficient through a multitransaction timer, passive release, PCI delayed transaction, and enhanced write performance. (For more details on Concurrent PCI, see "The Perfect Motherboard," *PC Magazine*, July 1996, page 147.) But if Intel's claim about its chip set is justified, why did virtually every system in this roundup perform so poorly on our video tests?

The benchmark tests that we ran include two video test suites: the Full-Screen Scaling tests and the High-Quality Action Cinepak tests. Both measure a system's ability to play back as well as scale full-motion .AVI files. When we ran these tests in past Pentium roundups (see "Pentium Classic: Still the One," June 25, 1996), we found that every system was able to play the video clips with virtually no problems, dropping very few frames, if any. But with these Pentium Pro systems, every machine dropped nearly all 450 frames on the Full-Screen Scaling tests, and most dropped a significant number on the High-Quality Action Cinepak tests as well. What happened?

The answer is simple: Windows NT Workstation 3.51 is not an ideal platform for video. Windows NT does not have the necessary extensions in place to allow a system's hardware (the graphics accelerator card and CPU) to talk intelligently to its software (the OS and graph-

ics card drivers), so software must handle hardware acceleration features such as scaling and color-space conversion. When the OS receives video-related requests, the processor must do all the work, because Windows NT doesn't know that the graphics card can do the

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Portable Property

August 1996Page 100
58 Pentium-class notebooks.

Pentium Classic: Still the One

June 25, 1996Page 100
101 Pentium-class desktops.

Beyond the Pentium

May 28, 1996Page 100
Four of the first Pentium-level Cyrix systems vs. Pentiums and Pentium Pros.

job better. The release of Windows NT Workstation 4.0 will rectify this situation: The platform supports ActiveMovie, DirectSound, and DirectDraw, letting the OS directly access the video and graphics hardware features.

Immature drivers are also at fault, because graphics board vendors haven't spent a great deal of time developing for the Windows NT platform. Given that Windows 95's market share is much larger than Windows NT's, it's not surprising that the former has enjoyed a much more extensive development effort on the part of independent software vendors.

PERFORMANCE

As we've learned in the past with Pentium systems, Pentium Pro machines require strong supporting components to take full advantage of the CPU's capabilities. Also as in previous Pentium roundups, we saw big gaps in performance between the best and worst: On our Winstone 32 tests, the score of the fastest unit (the Zenon Optima Pro Station) was 64 percent higher than that of the slowest (the Vektron Optima Pro Station). The most proficient PCs used the fastest hard disks (7,200-rpm Fast/Wide SCSI-2), powerful graphics cards, the Natoma chip set, and EDO DRAM.

If some of these features sound familiar, it's because we've written about them many times: They're the same speedy components that make up Pentium-based PCs. In contrast to our first Pentium Pro roundup and, indeed, to early advertising about Pentium Pro-based systems, we didn't see any components that you could consider out of the ordinary in a mainstream system.

But while many components remain the same, we did see the return of the caching hard disk controller on two machines: the Zenon Optima Pro Station, our Winstone 32 champ, and the Hertz Z-Pro200. A combination of other system components led the Hertz machine to an extremely low Winstone 32 score, but the Zenon system took full advantage of its controller/SCSI-2 hard disk combination. Subsequent testing found that the 16MB caching controller gave the Zenon box a 7 percent performance boost; with 64MB, the Winstone 32 score jumped 15 percent. You must decide whether the extra performance is worth the additional price for a caching disk controller; a 16MB card sells for about \$100 and a 64MB card for \$300 to \$1,000 or more (street prices).

Further testing showed that there's another performance booster: choosing FAT over NTFS. We required vendors to format hard disks using NTFS, because we feel it is simply the better way to go. Not only does NTFS use disk space more efficiently than FAT by breaking it up into small, consistent blocks, it also provides extensive security features and allows you to restore lost files after system failure. FAT leads in terms of performance, however: Our tests showed that a PC with a

PENTIUM PRO PCs

How to Read the Service & Reliability Boxes

We include ratings for vendors that received at least 50 responses on our latest Service & Reliability poll of 17,000 subscribers. These results reflect readers' experience with desktop PCs from a given vendor. For details of the poll, see our July 1996 issue.

The **reliability** rating is a measure of respondents' satisfaction with the reliability of the vendor's desktops in use over the past two years.

The **repair** rating is a measure of respondents' satisfaction with the repair service provided by the vendor for PCs in use over the past two years.

The **technical support** rating is a measure of respondents' satisfaction with the vendor's support for machines in use over the past two years.

The **percent needing repair** rating is a measure of the proportion of desktop machines that the respondents indicated needed repair during the past year. *Better than average* means that the incidence of needed repairs is significantly lower than average.

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Percent needing repair	Average



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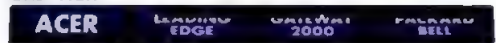
1ST TIER



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Source: PC World Reliability & Service Monitor, May 20 - November 20, 1995

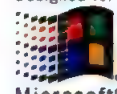


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FAT-formatted disk outperformed an NTFS system on Winstone 32 by about 12 percent. If you're willing to give up the added security features and some disk space, FAT may be for you.

DMI: WHERE'S THE MIF?

We found a lot to like about these PCs, but something was missing: DMI (Desktop Management Interface) support and MIFs (management information files). DMI is a spec that provides a bidirectional path to interrogate a PC's hardware and software. When a PC is DMI-enabled, its configuration can be monitored from a central network location. A MIF contains PC vital statistics and can start up routines to report errors to the network manager.

DMI consists of three layers: the management interface, which makes calls to DMI from console software (such as Intel's LANDesk); the service layer, which is the DMI's agent in the PC; and the component interface, which accesses the MIF and sends system data held in it back to the management console. While 12 PCs here are DMI-compliant (they have a memory-resident agent that can respond to management queries), only two are DMI-enabled with a MIF: one of our Editors' Choices, the NEC PowerMate Pro 2200, and the AST Bravo MS-T 6200. Without the MIF, the PC is unable to respond intelligently to queries, provide static data such as CPU type, or activate MIF routines to report errors to the management console as they occur. Hopefully, more PCs will be DMI-enabled in the future, as the technology will make network management easier and more cost-effective.

PENTIUM PRO'S FUTURE: THREE RIVERS RUN THROUGH IT

Pentium Pro developments may be quiet through the end of 1996, but 1997 is gearing up to be an exciting year for this CPU. Intel has not released any specifics about new Pentium Pro chips but some general information is available on the next four variations (three code-named after rivers

in California and Oregon).

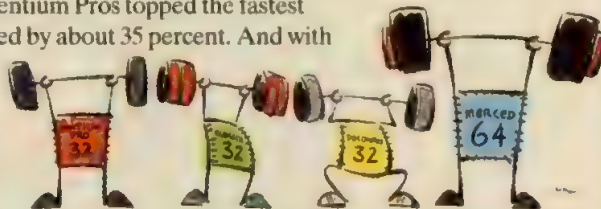
Klamath, built on the P854 process, is the most widely talked-about new Pentium Pro, since Intel plans to introduce it in the first half of 1997. The CPU will reportedly deviate from the Pentium Pro's current dual-cavity design (which mates the CPU and L2 cache in the same package), moving the L2 cache off-board. To make up for the performance hit (the L2 will run at system-bus speed instead of CPU speed), Klamath will reportedly have two to four times as much L1 cache as the current Pentium Pro, which has 8K for instructions and 8K for data. Chip speed should debut at 233 MHz and reach 266 MHz shortly thereafter.

External bus speed is equally important. Will Klamath support the 66-MHz external bus or ratchet up to supporting a

Pentium Pro Beats Classic at 32 Bits

Unquestionably, under a 32-bit operating system such as Windows NT 3.51 with only 32-bit applications, the Pentium Pro's performance soundly trounces the Pentium's, even when both are running at 200 MHz.

Using our benchmark test ZD Winstone 32, we found that the performance of this roundup's fastest Pentium Pros topped the fastest Pentium/200 we've tested by about 35 percent. And with only a 10 percent price gap between the two chips, you get your money's worth out of the Pentium Pro.



	▲ Higher scores represent better performance	▼ Lower scores represent better performance					
	Score	Min:sec	Min:sec	Min:sec	Min:sec	Min:sec	Min:sec
Pentium Pro/200							
NEC PowerMate Pro 2200	157	3:05	1:46	0:43	1:09		
SAG STA Pro 200 Desktop	189	2:55	1:43	0:40	1:03		
Zenon Optima Pro Station	174	2:51	2:08	0:33	0:57		
Pentium/200 (First Looks, 7/96)							
Dell Dimension XPS P200s	124	4:36	2:46	1:00	1:24		
Gateway P5-200XL	121	4:43	2:53	0:58	1:06		
IBM PC 350	122	4:53	2:56	0:57	1:08		
Micron Millennia P200	101	4:44	2:45	0:59	1:11		
Sys Performance P200T2	129	4:35	2:49	0:55	1:04		

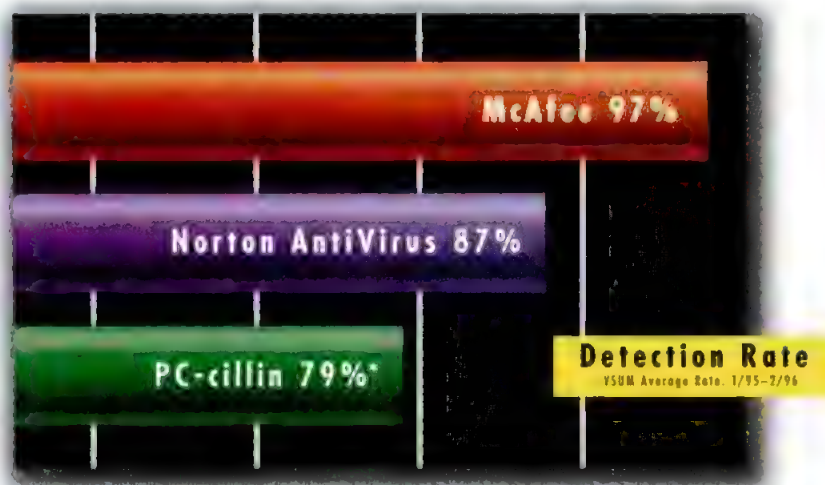
75-MHz design, as Cyrix's 6x86 P200+ has? We believe that both the 66-MHz system bus and the 33-MHz PCI bus are serious impediments to system performance, as are physical hard disk latencies, and that these slower I/O subsystems will hamper CPU-to-L1 improvements.

The new chip should be less expensive to manufacture than the current Pentium Pro, because of its single-chip design and a die shrink from the P6's current 0.35μ to 0.28μ. The actual die will be a bit larger than the Pentium Pro's because it will include Intel's MMX technology, a multimedia instruction set that Intel will build into every new processor starting with the P55C (see the sidebar "MMX and AGP: Bridging the Video Gap"). Intel will reportedly manufacture Klamath daughtercards featuring a separate bus directly linked to the cards' on-board L2 cache.

Deschutes will follow Klamath later in 1997. This chip represents a die shrink from Klamath's 0.28μ to 0.25μ. The processor should have smaller metal pitches and shorter transistors, so its die will be smaller, allowing high-volume,

Our Contributors: ROBERT S. ANTHONY is a senior writer, CADE METZ is a staff writer, BRUCE BROWN is a contributing editor, and MARY E. BEHR and ANUSH YEGYAZARIAN are staff editors at *PC Magazine*. MARGARET A. PIEMONTE is a technical analyst for PC Magazine Labs. FRANK J. EVANS is a freelance writer and frequent contributor to *PC Magazine*. CAROL VENEZIA was the associate editor in charge of this story, and RICHARD FISCO was the project leader.

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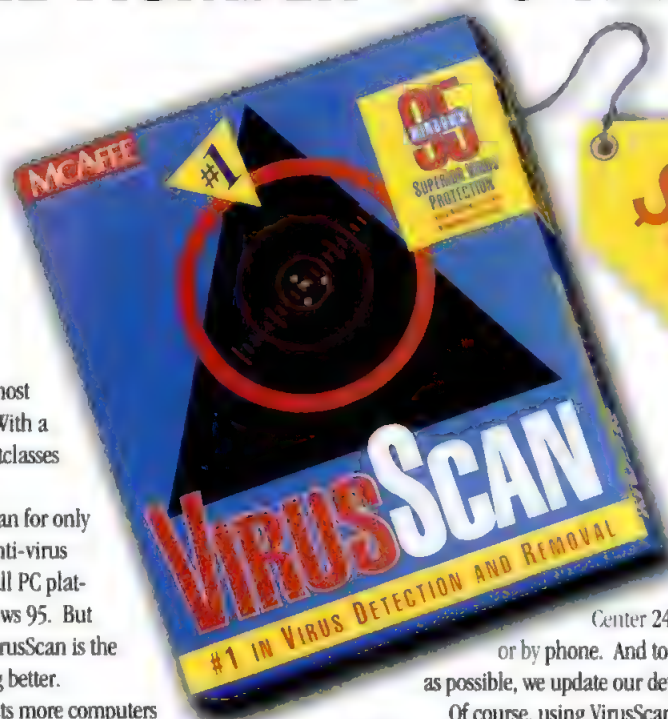
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Price/Performance Index: 200-MHz Pentium Pro PCs

Most of the PCs here strike a good balance between performance, features, and price, but several stand out. The \$3,471 NEC PowerMate Pro 2200, an Editors' Choice, has competitive performance and features designed for companies, including network and system management tools and a three-year service plan.

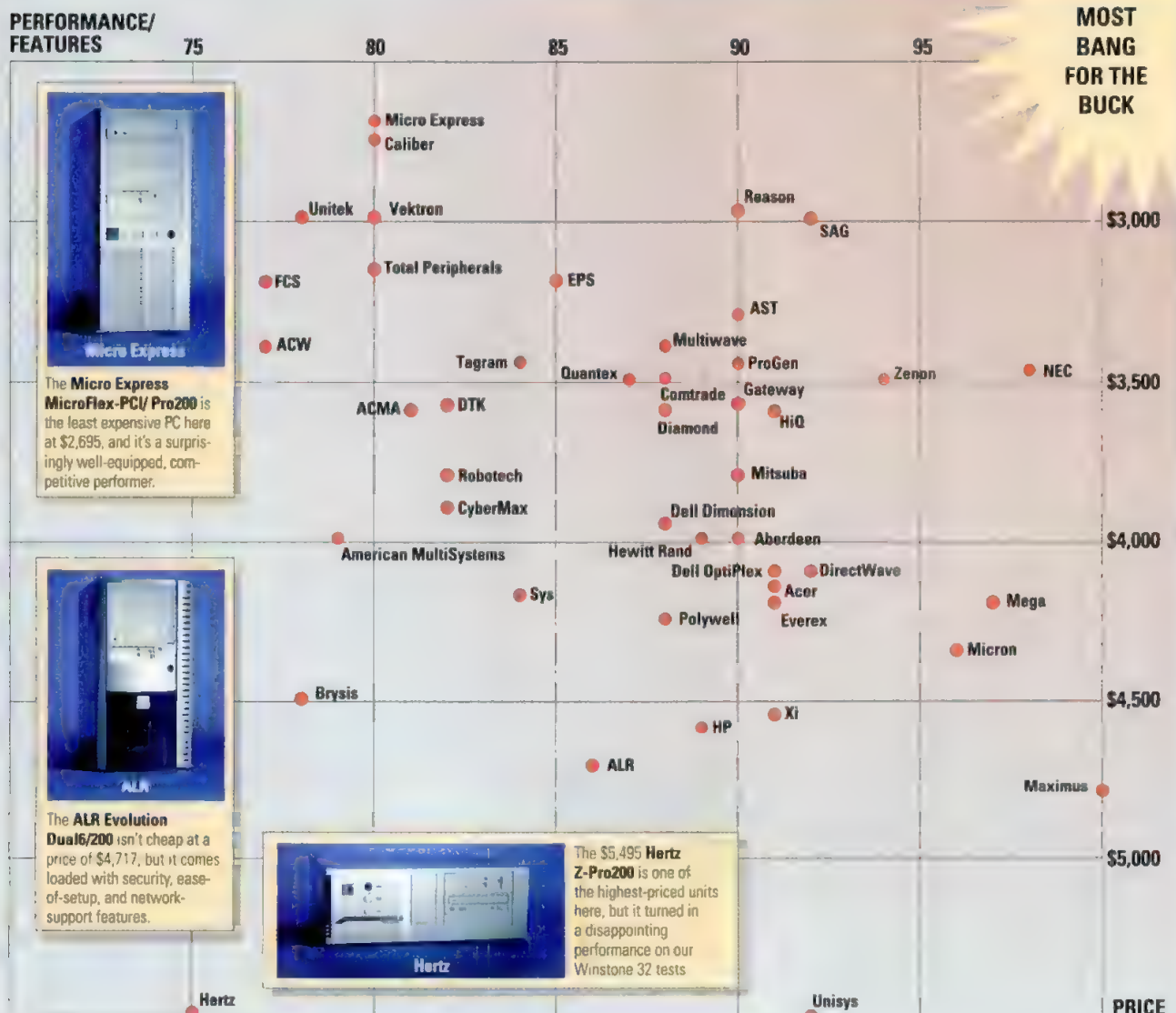
The SAG STA Pro 200 Desktop, another Editors' Choice, packs top-notch components such as Intel's Natoma chip set, a 2GB Seagate Fast/Wide SCSI-2 hard disk, and an Adaptec 2940UW ultrawide controller. It delivers class-leading performance, especially on our Winstone 32 and Adobe Photoshop tests—all for the bargain price of \$2,999.

The \$3,499 Zenon Optima Pro Station, also a first-rate performer, features a blazingly fast disk subsystem with a disk controller with 16MB of cache that led it to the roundup's best

Winstone 32 score and several other above-average test scores. Maximus's \$4,799 Magna Artist Pro got the best performance/features score by offering many of the high-end components of other PCs—with the same good performance—and sweetening the deal with a four-year on-site warranty.

THE DATA POINTS

We weight Winstone 32 and 32-bit-application test results at 35 percent, CD-ROM WinMark 96 results at 5 percent, monitor features at 15 percent, and warranty and other service terms at 12 percent. Hardware features, such as multiprocessor support and included network cards, complete the score. Look for price/performance index data in the Editorial Forum's Hardware Library on PC MagNet under 16BANG.TXT or on the Web at www.pcmag.com.



low-cost production of the part. It should also boost the chip's clock speeds to over 300 MHz by the end of 1997. Deschutes' shorter transistors may also permit a low-voltage version for notebook PCs.

The P68 (no river name yet) will succeed Deschutes in late 1997. We know only that it should be a high-powered version of the Pentium Pro while maintaining the basic P6 architecture.

Merced (formerly known as "P7") will be the first processor to use the 64-bit architecture that Intel and Hewlett-Packard are developing jointly. It is not due before the end of 1998 at the earliest.

BUT SHOULD YOU BUY IT?

If your company uses a 32-bit operating environment or plans to do so soon, we suggest that you consider the Pentium Pro for new purchases. In addition to being able to handle today's applications, it can provide investment protection for the future, which will definitely be all 32-bit.

Aberdeen Inc.

Aberdeen Dual Pro 200

The Aberdeen Dual Pro 200 (\$3,995 street) augments good performance with support for several burgeoning technologies. This tower system (which caters to the high-end corporate market, as well as to the home power-user set) offers DMI compliance, EDO DRAM, a USB port, and a 115.2-Kbps infrared interface from an accessible chassis. Such features also characterize Aberdeen's lower-end models, including the single-socket Aberdeen Pro, the Cyrix-based Power6, the P5 EIDE, and the P5 SCSI.

The unit boasts two swinging doors on either side of its chassis, allowing easy access to interior components. The SuperMicro motherboard, with Intel's Natoma chip set, accommodates two Pentium Pro CPUs.

A Matrox MGA Millennium graphics card, 4MB of WRAM, and a 2GB Seagate Barracuda ST32550W Fast/Wide SCSI-2 hard disk with a rotational speed of 7,200 rpm led the way to average scores on most of our tests. During CD-ROM WinMark 96 testing, an 8X Toshiba XM-5602B CD-ROM drive with an ATAPI interface secured above-average results.

Multimedia accessories include two



MIDI Land MLI-130 speakers and a 16-bit Creative Labs ISA sound card with FM synthesis. A 15.8-inch (measured diagonal screen size) Orchestra MultiSystems Tuba II monitor is slightly smaller than other monitors here, but a GVC 33.6/14.4-Kbps modem with voice mail, full-duplex speakerphone, and caller ID support is a welcome amenity.

The system's warranty covers parts and labor for one year. Four years of on-site service costs an additional \$229.95 (but \$99 for one year by the time you read this). Toll-free technical support is available during weekday business hours.

—Cade Metz

Aberdeen Dual Pro 200. Street price: \$3,995. Aberdeen Inc., Santa Fe Springs, CA; 800-552-6868, 310-801-5626; fax, 310-801-5629; www.aberdeeninc.com. Circle 441 on reader service card.

Acer America Corp.

AcerPower Pentium Pro

Boosted to great performance on some of our tests by a terrific SCSI-2 hard disk, and featuring several business-friendly accessories and a generous support policy, the corporate-oriented AcerPower Pentium Pro is more than worth its \$4,148 street price. Acer America Corp. also sells an AcerPower Business Multimedia machine, a value-based Acer-Entra PC, and a home line (the Acer-Aspire).

The AcerPower rode a 2GB Seagate 7,200-rpm Fast/Wide SCSI-2 hard disk

and an S3 Vision968-based Diamond Stealth graphics accelerator card with 2MB of VRAM to above-average scores on our Winstone 32 tests and both of our Adobe Photoshop tests. An Acer 8X CD-ROM drive led to an impressive CD-ROM WinMark 96 score, as well as an above-average CD-ROM Sequential 16K Read result. Even better, this top-notch performance on our CD-ROM tests did not overtax the CPU's processing capabilities: The AcerPower's CD-ROM CPU Utilization score was above average. The system's scores on all of our other tests were average.

Via a tool-free chassis, the unit augments an Acer-built motherboard with the Intel Natoma chip set and 32MB of EDO DRAM. The mini-tower unit also features a USB port, Energy Star compliance, and DMI support. In addition to boasting an Acer CD-ROM drive, the AcerPower comes with a 17-inch Acer 761E color monitor that's both DDC1- and DDC2-compliant. Audio capability comes from two Quickshot SF550 speakers and a 16-bit Creative Labs Sound Blaster audio card capable of wavetable synthesis.

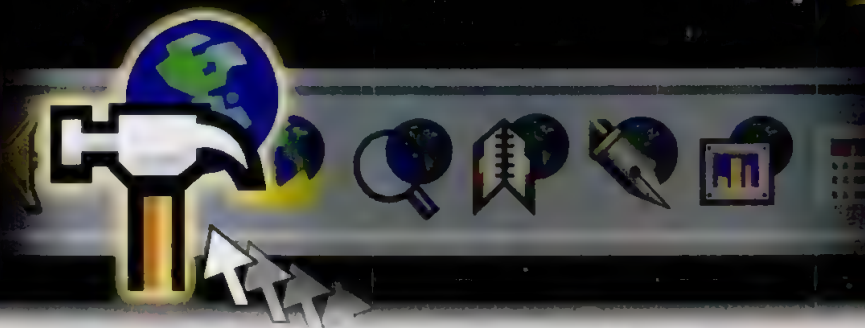
Microsoft Windows NT 3.51 is currently preloaded with the unit, but Acer plans to offer free Windows NT 4.0 upgrades when the operating system ships. Acer also offers a three-year parts-and-

SERVICE & RELIABILITY

Acer America Corp.

Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Average

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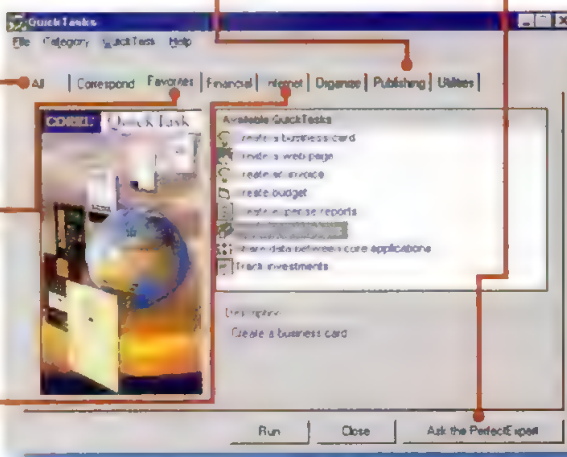
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AcerPower Pentium Pro. Street price: \$4,148. Acer America Corp., San Jose, CA; 800-445-6495, 408-432-6200; fax, 408-434-0556; www.acer.com/aac. Circle 442 on reader service card.

ACMA Computers Inc.

zPower Pro 200

ACMA Computers' \$3,595 zPower Pro 200 offers modest performance at a relatively low price, distinguishing itself with simple installation and easy serviceability. The system includes a helpful setup poster, clearly labeled ports, a chassis that opens without tools, and a motherboard that is easily accessible inside the unit's midtower case. The company aims this Pentium Pro machine at demanding corporate users who require strong multimedia support. The vendor's zPower and sPower Pentium-based PC lines cover, respectively, the high and low ends of the Windows 95-based corporate market.

The Energy Star-compliant zPower Pro is a squat midtower system, with only two external 5.25-inch drive bays available for expansion and no empty 3.5-inch bays. Internally, it features a single-CPU Intel Venus motherboard and the Natoma chip set. The system also provides EDO DRAM, Microsoft Office Pro 7.0, an Impression Vienna 17-inch monitor that is both DDC1- and DDC2-compliant, two Altec Lansing ACS51 speakers, and a 16-bit Creative Labs ISA sound card with FM synthesis support.

The system's 2GB Seagate Medalist ST32140A Fast ATA-2 hard disk and Matrox MGA Millennium graphics card with 4MB of VRAM fostered predominantly average benchmark test and performance test scores. An 8X ATAPI Toshiba CD-ROM drive led to an above-average CD-ROM WinMark 96 result.

The company provides technical support only on weekdays, but its three-year-parts and one-year-labor warranty includes a year of on-site service.—CM

zPower Pro 200. Direct price: \$3,595. ACMA Computers Inc., Fremont, CA;



800-786-6888, 510-623-1212; fax, 510-623-0818; www.acma.com. Circle 443 on reader service card.

ACW (All Computer Warehouse)

ACW P6-200DS

Although some test scores were low for the ACW P6-200DS, the unit has several welcome characteristics, including a voice-capable modem and a street price of only \$3,398. Unlike many systems in this roundup, the P6-200DS uses Intel's Orion core-logic chip set rather than the newer Natoma chip set. ACW also offers the P6-200DD Pentium Pro line, which uses Intel's Natoma chip set, as well as a line of Pentium machines.

This tower system is built around the single-socket Intel Aurora motherboard and an impressive 2GB Seagate Fast ATA-2 hard disk. The system uses EDO DRAM, although the Orion chip set does not support the technology.

Because of components such as an S3 Vision968-based Diamond Stealth graphics accelerator card with only 2MB of VRAM, the P6-200DS turned in below-average scores on a number of our tests, including the AutoCAD test and both Adobe Photoshop tests. Its CPUmark₃₂ score was also below par. An 8X ATAPI Toshiba XM-5602B CD-ROM drive, however, led to a fantastic CD-ROM WinMark 96 score and an above-average CD-ROM Sequential 16K

Read result. But these good scores come at a price, manifested in the unit's below-average CD-ROM CPU Utilization score. The unit's scores on our Winstone 32 and C Compiler tests were average.

The system also includes Microsoft Office with Bookshelf and a U.S. Robotics Sportster Voice 28.8/14.4-Kbps modem with voice mail and full-duplex speaker-

phone support. ACW completes the hardware package with a 17-inch MAG InnoVision DX1795 monitor that is DDC1- and DDC2-compliant, a 16-bit Sound Blaster audio card with wavetable and FM synthesis support, and two MIDI Land MLI-691H speakers.

ACW covers parts and labor for one year; on-site service for one year is \$129.95. Toll-free technical support is provided Monday through Friday.—CM

ACW P6-200DS. Street price: \$3,398. ACW (All Computer Warehouse), City of Industry, CA; 800-775-1953, 818-369-4181; fax, 818-961-7462; www.allcomp.com/acw. Circle 444 on reader service card.

Advanced Logic Research Inc.

ALR Evolution Dual6/200

With a \$4,717 price tag and several low scores on our benchmark and performance tests, the chief assets of the ALR Evolution Dual6/200 are security, easy setup, and network support. This dual-CPU mini-tower is marketed as a

high-end corporate PC, a graphics workstation, and a server. The Evolution line includes a complete range of Pentiums as well. ALR also offers an Optima line of value-based Pentium PCs and a Revolution server line.

The Dual6/200's motherboard is built by ALR and uses Intel's Orion chip set. Components including a 1.5GB Western Digital EIDE hard disk and a Diamond Stealth64 Video VRAM 3240 graphics

SERVICE & RELIABILITY

Advanced Logic Research Inc.	
Reliability	Average
Repair	Average
Technical support	Worse than average
Percent needing repair	Average

THANKS.

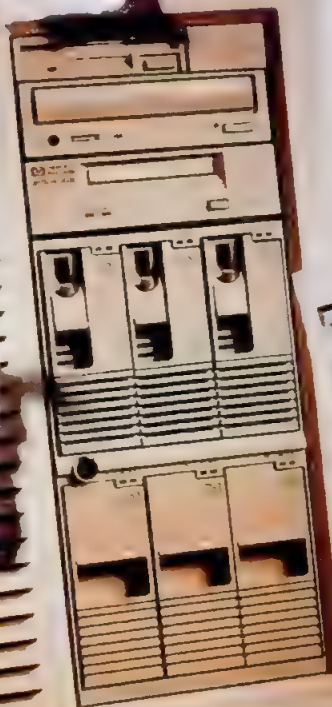
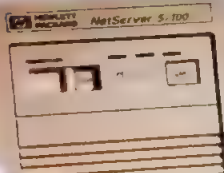
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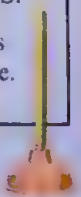
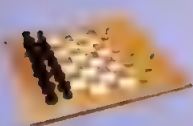


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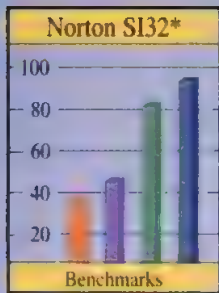
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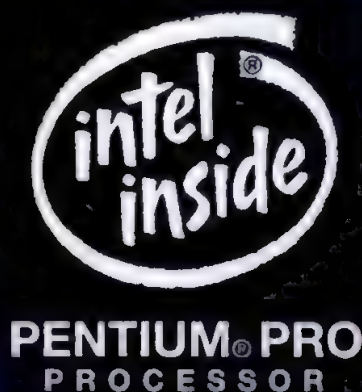


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card with 4MB of VRAM helped the system post average scores on our Winstone 32 and CPUmark₃₂ tests. On our AutoCAD and Adobe Photoshop tests, however, the Dual6/200 posted the slowest timings of all systems reviewed. The unit's 4X Sanyo CD-ROM drive led to a below-average CD-ROM WinMark 96 score; a 6X Mitsumi drive will be standard, however, by the time you read this.

The system includes a 17-inch MAG InnoVision DX1795 monitor that is DDC1-, DDC2-, and Energy Star-compliant. It also offers a 16-bit Creative Labs sound card and two Labtec CS-600 speakers. In the security and setup arenas, the unit has a chassis keylock, a keyboard/mouse inhibit switch, a locking drive-bay cover, a setup poster, and well-labeled ports. This product will support full DMI compliance and Intel's LANdesk by the end of the year.

The unit comes bundled with a Cogent EM110 PCI 10/100 Fast Ethernet adapter and ALR's InforManager, which monitors system thermals, fan speeds, and motherboard voltages.

A five-year-parts, three-year-labor warranty is included; on-site service is \$9.95 for the first year and \$74.95 for the next two years.—CM

ALR Evolution Dual6/200. Street price: \$4,717. Advanced Logic Research Inc., Irvine, CA; 800-444-4257, 714-581-6770; fax, 714-581-9240; www.alr.com. Circle 445 on reader service card.

American MultiSystems Inc.

InfoGold PP200C

American MultiSystems' InfoGold PP200C (\$3,995 street) boasts a Fast Ethernet adapter and DMI compliance, but the unit faltered on some of our disk-intensive tests. With almost 90 percent of its customer base coming from the high-end corporate market, this Energy Star-compliant midtower is the keystone of American MultiSystems' desktop offerings. Other lines sold by the vendor include the InfoGold PP400GX line of high-end dual-Pentium Pro graphics workstations and a complete offering of Pentium machines.

The PP200C that we tested had an Intel VS440FX motherboard with Intel's Natoma chip set and EDO DRAM. A Matrox MGA Millennium graphics accelerator with 4MB of WRAM guided the graphics subsystem. Two Sony speakers and a DDC1-compliant Sony Artmedia SE monitor were also present, but the system's most distinguishing feature was a bundled 3Com 595TX PCI 10/100 Fast Ethernet card.



In terms of performance, the PP200C's 2.5GB Quantum Sirocco Fast ATA-2 hard disk was a drawback. This 5.25-inch drive is extremely quiet, but it spins at only 4,200 rpm, whereas the vast majority of the other machines in this roundup had 5,200-rpm and faster disks. Consequently, the unit's scores on both of our Adobe Photoshop performance measures were below average, and its Winstone 32 score was barely average. All of the other benchmark test scores were average, however, with the exception of a disappointing CD-ROM WinMark 96 score. The system's Toshiba XM-5522B CD-ROM drive operates at 6X speed, but it had poor random-access times.

American MultiSystems' warranty covers a year of parts and labor. On-site service is an additional \$85 for one year. Toll-free technical support is offered six days a week.—CM

InfoGold PP200C. Street price: \$3,995. American MultiSystems Inc., Milpitas, CA; 800-888-6615, 408-945-2296; fax, 408-945-2299; www.infogold.com. Circle 446 on reader service card.

AST Computer

Bravo MS-T 6200

AST Computer's Bravo MS-T 6200 is buoyed by its \$3,300 street price, DMI support, software bundle, and round-the-clock technical support, which make up for decidedly lackluster performance. As the high-end machine of AST Computer's Bravo line, which also includes Pentium-based PCs, this system is aimed at the top of the corporate market. AST plans to offer free Windows NT 4.0 upgrades to customers who purchase systems with Version 3.51.

This mini-tower offers sufficient expansion options. Conveniently, its Intel Performance/VS motherboard (which makes use of EDO DRAM and Intel's 440FX core-logic chip set) slides out for servicing after the removal of only two screws. The unit's multimedia hardware includes a headset with a microphone, integrated Creative Labs 16-bit sound, two Labtec C33 speakers, and a 17-inch AST Vision 7L Energy Star-compliant monitor.

Using a 2.4GB Western Digital Caviar EIDE hard disk and a Matrox MGA Millennium graphics card with 2MB of WRAM, the Bravo MS-T 6200 turned in a below-average Winstone 32 score. All other test scores were average, save a below-average showing on our CD-ROM WinMark 96 tests. The system's Toshiba XM-5622B ATAPI runs at 6X during sequential reads, but it is slow during random-access reads.

This DMI-compliant machine is one of only two units in this roundup that are also DMI-enabled, as AST bundles a MIF browser as well. The

unit also comes with Netcom NetCruiser, Netscape Navigator for Windows NT, the HTML editor HoTMetaL Lite, and the AST Command Center, which offers virus scanning, equipment and software tracking via DMI, voice recognition, sound-file manipulation, and remote monitoring and querying.

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Repair	Average
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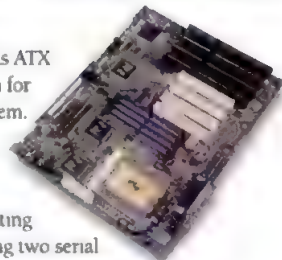
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BENCHMARK TESTS

Pentium Pro PCs



These 45 machines demonstrate that optimized subsystems and top-rated components are the keys to unleashing the power of a 200-MHz Pentium Pro desktop PC. Our benchmark tests bore this out, revealing broad performance gaps between the fastest and the slowest machines.

What the Numbers Mean

ZD Winstone 32 The most effective subsystems combined Fast or Fast/Wide 7,200-rpm SCSI-2 hard disks and powerful graphics cards from Matrox, Number Nine, or Diamond. Also, systems featuring Intel's second-generation 440FX core-logic chip set (code-named Natoma) outscores PCs using the first-generation 450KX or 450GX chip sets (code-named Orion) by an average of 12 percent on ZD Winstone 32. Natoma supports PCI revision 2.1 and can enable more than 100 MBps of data streaming between PCI peripherals and DRAM. It also supports PCI bus masters and concurrent PCI transactions to main memory.

The Zenon Optima Pro Station, our Winstone 32 leader, came with a CMD hard disk controller with 16MB of RAM cache. (PC Labs has not seen the addition of a caching hard disk controller in years.) On Windows 3.x PCs with older ISA bus designs, a hardware cache delivered little if any performance boost over the operating system's software cache. But it did benefit the Windows NT/SCSI disk/PCI bus combination. Testing by PC Labs showed that the Zenon gained about a 7 percent boost in Win-

▲ Higher scores represent better performance.
▼ Lower scores represent better performance.
Bold type denotes first place.

	ZD WINSTONE 32 Score	ZD CPUMARK₃₂ Score	AUTOCAD Minutes:seconds	C COMPILER Minutes:seconds	PHOTOSHOP GAUSSIAN BLUR Minutes:seconds
Aberdeen Dual Pro 200	162	511	2:59	1:50	0:43
AcerPower Pentium Pro	167	534	3:10	1:46	0:40
ACMA zPower Pro 200	154	543	3:05	1:47	0:47
ACW P6-200DS	135	460	3:35	2:02	0:59
ALR Evolution Dual6/200	137	521	3:40	1:53	1:11
American MultiSystems InfoGold PP200C	138	525	3:13	1:51	0:59
AST Bravo MS-T 6200	127	528	3:08	1:47	0:46
BDI PP-200NT System	134	509	3:27	2:00	1:00
Caliber Voyager Pro	135	487	3:10	1:58	0:52
Comtrade Wide SCSI Powerstation	124	471	3:16	1:51	0:31
CyberMax ProMax 200	143	443	3:32	1:58	0:44
Dell Dimension XPS Pro200n	168	532	3:06	1:45	0:37
Dell OptiPlex GXpro 200	160	515	3:14	1:46	0:52
Diamond DT Advance Pro-200	127	514	3:17	1:49	0:40
DirectWave Blue Thunder PN200S	165	549	2:54	1:44	0:35
DTK Apri-31M/200	155	537	3:18	1:49	0:41
EPS Evolution XL-Pro200	160	540	3:13	1:48	0:44
Everex STEP DPi/Pro	161	558	2:54	1:46	0:38
FCS Pentium Pro-200 System	145	501	3:08	1:57	0:57
Gateway G6-200	153	526	3:10	2:04	0:49
Hertz Z-Pro200	110	507	3:18	1:52	0:31
Hewlett Rand PP200 Mission Critical	163	519	3:09	1:48	0:38
Hewlett-Packard Vectra VA 6/200 MT	157	542	2:56	1:44	0:37
	BETTER ►	BETTER ►	◄ BETTER	◄ BETTER	◄ BETTER

(1) With an Action, Indeo, 160 x 120, 30-fps, 300-KBps clip scaled to full screen (1,024 x 768)
(2) With an Action, Cinepak, 640 x 480, 30-fps, 900-KBps clip

stone performance from the 16MB of cache. Further testing showed that when the unit used the largest available SIMM module the controller could handle (64MB), performance rose by 15 percent. Keep in mind that this is an expensive proposition: A 16MB card from CMD costs about \$100 and a 64MB card about \$390.

The second-lowest-scoring system on the Winstone 32 tests, the Hertz Z-Pro200, came with the same caching controller as the Zenon, but the controller didn't help performance. We suspect that the combination of motherboard memory timings and a poorly tuned graphics driver for the system's Mach 64-based ATI graphics card contributed to the low score. The Vektron Optima Pro Station, which turned in the lowest Winstone 32 score, did not employ a caching controller but was the only system to use a Diamond Stealth 3D 2000 Virge graphics card. Diamond aims the Virge chip at both 3-D games graphics and standard 2-D business graphics; the chip offers such features as Gouraud shading and bilinear and trilinear texture filtering. We believe the graphics board's driver was not fully optimized for business graphics.

ZD CPUmark₃₂ Chip sets for Pentium Pro processors currently come only from only one supplier, Intel; we saw the Orion chip set in 17 systems and the Natoma chip set in 28 systems. Natoma supports fast EDO DRAM as well as burst EDO DRAM, while Orion supports only fast-page-mode DRAM. The roundup's Natoma-equipped machines benefited from the use of EDO DRAM, outscoring the Orion machines on this CPUmark measure by about 8 percent.

C Compiler Our C Compiler test consists of a set of C source code modules that you can use to build World Wide Web servers, clients, and proxies. The test compiled the code modules into a 32-bit DLL library with Version 7.2 of Symantec's C++ development environment. The top performers were the SAG STA Pro 200 Desktop and the HP Vectra VA 6/200 MT, which ably handled the heavy disk I/O needed to finish this test.

AutoCAD The AutoCAD test exercises a broad range of system capabilities, including the CPU's integer and floating-point capa-

Continues

PHOTOSHOP LIGHTING EFFECTS		ZD CD-ROM WINMARK 96		CD-ROM Sequential 16K Read		FULL-SCREEN SCALING ¹		HIGH-QUALITY ACTION CINEPAK ²	
Minutes:seconds		Score		Kbps	CPU Utilization	Frames Dropped	CPU Utilization	Frames Dropped	CPU Utilization
1:09		882		1,220	82%	419	99.5%	276	99.7%
1:03		732		1,190	55%	419	99.2%	147	99.8%
1:13		746		1,220	87%	421	99.9%	244	99.7%
1:19		856		1,220	87%	421	99.9%	395	99.9%
1:43		432		612	64%	432	88.5%	421	98.9%
1:27		573		916	74%	431	81.3%	387	99.2%
1:07		578		919	75%	422	99.9%	432	99.9%
1:26		585		1,190	87%	431	84.8%	378	99.5%
1:14		680		918	60%	421	99.9%	432	99.9%
0:57		826		1,230	73%	420	99.8%	353	99.8%
1:09		722		1,030	81%	434	80.6%	431	99.6%
1:04		564		1,220	87%	421	99.9%	260	99.8%
1:19		414		612	37%	430	88.6%	414	98.5%
1:02		745		1,020	82%	422	99.9%	399	99.8%
1:00		897		1,220	61%	431	74.3%	174	99.3%
1:12		600		1,190	87%	431	82.4%	364	99.3%
1:14		560		1,010	87%	432	85.4%	412	99.2%
1:13		623		1,040	87%	423	99.9%	345	99.7%
1:20		540		918	73%	431	84.7%	399	99.0%
1:09		649		1,140	87%	422	99.9%	314	99.8%
1:02		742		1,030	80%	422	99.9%	404	99.9%
1:04		744		1,030	77%	432	78.8%	412	99.4%
1:00		786		1,220	19%	419	99.4%	43	89.9%

◀ BETTER

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Echos P100E

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100MHz Pentium processor, 8MBsd, 40MBmax RAM, 11.4" TFT display, PCI Bus, 2.56K I/O cache, 1.5GB removable HDD, 800x600 SVGA resolution, Multimedia I/O, 6X CD-ROM and modular HDD (st. or second battery opt.)

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133MHz Pentium processor, 16MBsd, 40MBmax RAM, 11.8" TFT display, PCI Bus, 2.56K I/O cache, 1.5GB removable HDD, 800x600 SVGA resolution, Multimedia I/O, 6X CD-ROM and modular HDD (st. or second battery opt.)

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BENCHMARK TESTS

Continued

bilities and the power of the disk and video subsystems. The roundup's two top-scoring systems, the Zenon Optima Pro Station and the ProGen Nova II 200MHz, used a Matrox MGA Millennium graphics card. In fact, the top five scorers in the roundup all used this card.

Adobe Photoshop Our Adobe Photoshop application tests include two filters, Gaussian Blur (which stresses integer calculations) and Lighting Effects (which stresses floating-point operations). Both require heavy disk I/O for completing the tasks. From previous testing, we've found that the amount of installed memory also contributes heavily to test results: Systems with 64MB of memory can complete these filters in half the times reported here, which reflect 32MB configurations. The Mitsuba Premier-Pro 200 and the Comtrade Wide SCSI Powerstation finished first and second, respectively, on both the Gaussian Blur and the Lighting Effects tests.

ZD CD-ROM WinMark 96 Nearly half of this roundup's 45 systems came with 8X CD-ROM drives. Eleven 6.7X drives, seven 6X drives, and five 4X drives rounded out the field. The top-scoring

SCSI drive was the Plextor PX-83CS, while the top-scoring ATAPI drive was the Toshiba XM-5602B; both posted nearly identical CD-ROM WinMark scores.

Video Tests Our video tests consist of clips that stress both the graphics and the CD-ROM subsystems. We chose a 320-by-200 clip authored at 900KBps and a 160-by-120 clip authored at 300 KBps that scales up to full screen (1,024 by 768). We can draw one conclusion from the results: Windows NT is not the platform of choice for video. It does not support DCI (Display Control Interface), DirectDraw, or DirectSound, so there can be no intelligent communication and load balancing between the hardware (graphics card and CPU) and software (OS and graphics card driver). Thus, when asked to scale up a video clip to full screen, the OS is unaware that the graphics engine can handle the job more efficiently, and it lets the CPU do all the work. This explains why all of this roundup's systems dropped nearly all the frames they had to display on the Full-Screen Scaling tests. Windows NT 4.0 will reportedly include the DirectDraw and DirectSound extensions to Windows 95 (as well as a new video playback API called ActiveMovie), but only Windows 95 will have the rest of the DirectX library, making that the entertainment

▲ Higher scores represent better performance
▼ Lower scores represent better performance
Bold type denotes first place.

HiQ Venue Station

Maximus Magna Artist Pro

Mega Double Impact Pentium Pro 200

Micro Express MicroFlex-PCI/Pro200

Micron Millennia Plus Pro200

Mitsuba Premier-Pro 200

Multiwave Pro Power

NEC PowerMate Pro 2200

Polywell Poly P6-200N

ProGen Nova II 200MHz

Quantex QP6/200 WS-2

Reason Square 6 NA/VA

Robotech Cobra XLP Pro 200

SAG STA Pro 200 Desktop

Sys Performance Pro 200

Tagram Thunderbolt Corporate T6

Total Peripherals Lightning

Uniays Aquanta DM/6

Unitek UT-PP200 Commando

Veltron Optima Pro Station

Xi Pro200 MTower DP/SP

Zenon Optima Pro Station

ZD WINSTONE 32

Score

189

162

163

138

164

162

153

157

150

154

141

158

129

169

142

149

147

147

139

106

155

174

BETTER ►

ZD CPUMARK₃₂

Score

538

491

539

497

542

531

469

550

529

551

479

528

484

539

521

495

471

506

484

536

541

528

BETTER ►

AUTOCAD

Minutes:seconds

3:00

3:04

2:54

3:17

3:07

3:27

2:54

3:05

3:17

2:40

3:31

3:05

3:35

2:55

3:14

3:04

3:23

3:18

3:34

3:33

3:00

2:51

◀ BETTER

C COMPILER

Minutes:seconds

1:45

1:50

1:47

1:57

1:45

1:44

1:53

1:46

2:08

1:48

1:58

1:46

2:00

1:43

1:55

1:55

2:07

1:58

1:53

1:54

2:06

2:08

◀ BETTER

PHOTOSHOP GAUSSIAN BLUR

Minutes:seconds

0:37

0:37

0:39

0:48

0:42

0:29

0:43

0:43

0:48

0:51

0:48

0:42

0:57

0:40

0:47

0:35

0:48

0:55

0:51

0:47

0:45

0:33

◀ BETTER

(1) With an Action, Indeo, 160 x 120, 30-fps, 300-KBps clip scaled to full screen (1,024 x 768)
(2) With an Action, Cinepak, 640 x 480, 30-fps, 900-KBps clip

platform of choice.

The High-Quality Action Cinepak tests, using a video clip authored at 900 KBps, stress the CD-ROM subsystem. A 6X CD-ROM drive should be able to handle a 900-KBps throughput rate, but even systems with 8X drives had trouble with the tests, dropping many frames. Two notable exceptions were the Maximus Magna Artist Pro and the Micron Millennia Plus Pro200. Both used the Plector PX-83CS 8X CD-ROM drive and dropped few frames. We also tested some of these systems under Windows 95 and found that they dropped about half as many frames as with Windows NT.—*Analysis written by Richard Fisco*

How We Tested

We tested each system running Windows NT Workstation 3.51 with 32MB of RAM, a 4X or faster CD-ROM drive, and a 1.6GB or larger hard disk, formatted for NTFS (NT File System) instead of FAT. NTFS has many more features than FAT, including file system recovery for quick restoration of disk-based data after a system failure, and the much-promoted security features that allow various levels of access. NTFS also handles disk space more efficiently than FAT or even Windows 95's VFAT. There is a drawback to using NTFS instead of FAT, however: When PC Labs

converted some systems to FAT and again ran ZD Winstone 32, the systems realized a performance boost of about 12 percent. We believe the benefits of NTFS are strong, and we will continue to test with that format. But you should consider the performance loss when setting up a Windows NT PC.

For all except the Photoshop tests, we used the vendor's pre-installed graphics driver for 1,024-by-768 resolution with 256 colors and small fonts. For the Photoshop tests, we set each machine to 800-by-600 resolution with 16.7 million colors and small fonts.

We used our benchmark test program **Winstone 32, Version 1.0**, to measure the units' performance when running eight best-selling 32-bit Windows applications under operating systems such as Windows 95 and Windows NT 3.51. Winstone 32 times the execution of a set of scripts that use these applications. The program weights timings based on the applications' market share and converts them to a relative score. Specifically, this score is relative to the performance of a Dell 425s/P with 8MB of RAM running Windows 95 and MS-DOS 7.0, which has a score defined as 10.

We used portions of our benchmark test program **WinBench 96, Version 1.0**, to measure processor, CD-ROM, and motion video per-

Continues

PHOTOSHOP LIGHTING EFFECTS		ZD CD-ROM WINMARK 96		CD-ROM Sequential 16K Read KBps	CPU Utilization	FULL-SCREEN SCALING ¹		HIGH-QUALITY ACTION CINEPAK ²	
Minutes:seconds		Score			▼	Frames Dropped ▼	CPU Utilization ▼	Frames Dropped ▼	CPU Utilization ▼
1:05		878		1,220	87%	419	99.7%	218	99.7%
1:06		895		1,220	20%	417	96.9%	48	92.1%
1:13		751		1,020	77%	420	99.7%	381	99.7%
1:19		690		848	67%	421	99.9%	430	99.9%
1:05		898		1,220	16%	417	96.5%	31	86.7%
0:55		642		1,100	87%	422	99.9%	317	99.7%
1:03		500		613	15%	420	97.4%	442	100%
1:09		578		1,220	85%	441	31.5%	422	37.7%
1:14		743		1,030	87%	432	80.9%	392	99.2%
1:06		554		1,360	87%	431	81.0%	258	99.0%
1:10		738		1,020	77%	424	99.9%	421	99.8%
1:16		554		918	61%	421	99.9%	436	99.9%
1:19		547		1,190	83%	432	82.9%	417	99.6%
1:03		617		1,020	87%	431	84.3%	373	99.3%
1:14		580		612	87%	422	99.9%	441	100%
1:00		744		1,020	82%	432	79.3%	431	99.6%
1:09		714		1,150	79%	432	78.7%	417	99.5%
1:18		495		614	24%	424	99.9%	442	100%
1:21		523		916	85%	432	86.0%	423	98.4%
1:11		630		1,040	87%	430	87.9%	404	99.5%
1:10		737		1,030	87%	432	81.1%	388	99.4%
0:57		659		919	41%	432	71.2%	328	99.2%

◀ BETTER

BETTER ▶

BENCHMARK TESTS

Continued

formance under Windows NT. The **CPUmark₃₂** score gauges the speed of a PC's processor subsystem (which includes the CPU, secondary cache, and system RAM) under 32-bit operating systems.

The **CD-ROM WinMark 96** tests gauge the performance of a machine's CD-ROM subsystem, which includes the CD-ROM drive, its adapter, and its required software drivers. This test is based on a profile of six of today's most popular Windows CD-ROMs. We also report on the **CD-ROM Sequential 16K Read** test, which measures the CD-ROM subsystem's throughput as it reads 16K blocks of data on a CD-ROM. The **CD-ROM CPU Utilization** score refers to the percentage of the processor's bandwidth occupied in servicing the CD-ROM subsystem while it retrieves data. To determine this score, WinBench 96 uses a default block size of 16K. The transfer rate defaults to the maximum rate of the particular CD-ROM subsystem. WinBench 96 calculates this transfer rate before it runs the tests.

WinBench 96 also includes Video Test, a suite of 33 video clips that test the ability to play full-motion .AVI files. You can use two types of clips at a variety of data and frame rates, with either the Indeo or the Cinepak codec.

We report on the **Full-Screen Scaling** tests, which use an Action, Indeo, 160-by-120, 30-fps, 300-KBps video clip; and on the **High-Quality Action Cinepak** tests, which use an Action, Cinepak, 640-by-480, 30-fps, 900-KBps video clip.

APPLICATION TESTS

Tests in Adobe Photoshop time the application of two filters to an

image; they stress floating-point processing. The **Photoshop Gaussian Blur** filter blurs a selection by an adjustable amount; it adds low-frequency detail and can produce a hazy effect. We applied a blur of radius 25 to a 15MB TIFF image. The **Photoshop Lighting Effects** filter lets you apply up to 16 different light sources to an image; three types of lights and five lighting styles are possible. We tested with default spotlight settings applied to an 18.5MB TIFF image.

Our **AutoCAD** test exercises a broad range of system functions, including the CPU's integer and floating-point capabilities and disk and video subsystem abilities. We time three tasks: opening 2-D and 3-D drawing files, performing 2-D manipulations (including new entity additions, entity deletions, undo commands, regens, zooms, and pans), and performing 3-D manipulations (including view rotations and alterations, the HIDE command, move operations, and a variety of rendering variations).

Our **C Compiler** test stresses overall processing capability. We employed the World Wide Web Consortium (W3C) Reference Library Benchmark, which consists of a set of C source code modules, largely platform-independent, which you can use to construct World Wide Web servers, clients, and proxies. The World Wide Web Consortium library is provided by CERN and has 119 files that contain 1.1 million bytes of software source code. We timed the compilation of these files into a 32-bit DLL library with Symantec's C++ 7.2 development environment, with each system running under the Windows NT 3.51 platform.

parts-and-labor warranty and free on-site service for the first year.—*CM*

Bravo MS-T 6200. Street price: \$3,300. AST Computer, Irvine, CA; 800-876-4278, 714-727-4141; fax, 714-727-9355; www.ast.com. *Circle 447 on reader service card.*

Brysis Data Inc.

BDI PP-200NT System

Although the BDI PP-200NT, at \$4,499 (street price), is on the expensive side compared with other systems in this roundup, Brysis Data jeopardizes the system's performance by skimping on its hard disk. The rest of the BDI line of PCs consists of 100- to 166-MHz Pentium PCs. Brysis, which has been in the PC business for six years, sells through dealers and wholesalers and aims this system at high-end corporate users.

The BDI PP-200NT's motherboard, a SuperMicro Super P6DNF, uses the Intel 440FX chip set and EDO DRAM. The 1.9GB NEC DSE 2010A EIDE hard disk spins at a comparatively slow 4,500 rpm. This hardship—coupled with

a Diamond Multimedia Stealth64 Video VRAM 3240 graphics card with 4MB of VRAM—led to below-average results on our Winstone 32 and Adobe Photoshop Gaussian Blur and Lighting Effects tests, all of which are heavily disk-intensive.

All other benchmark test scores were average, but a Hitachi CDR-7930 ATAPI CD-ROM drive contributed to a below-average CD-ROM WinMark 96 score. The BDI PP-200NT also includes two Hercules G-650 speakers, a Funai 6DI 17-inch Energy Star-compliant monitor, and a 16-bit Creative Labs ISA sound card that supports wavetable, waveguide, and FM synthesis.

Regardless of Microsoft's future Windows NT policy, Brysis will charge customers for upgrades from Version 3.51 to 4.0. The company offers a warranty that covers one year of parts and a lifetime of labor. A year of on-site service is \$150, and technical support is available during business hours.—*CM*
BDI PP-200NT System. Street price: \$4,499. Brysis Data Inc., City of Industry, CA; 818-810-0355; fax, 818-810-4555. *Circle 448 on reader service card.*

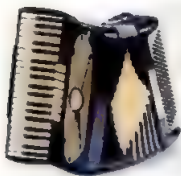
Caliber Computer Corp.

Voyager Pro

Despite slightly below-average benchmark test scores, Caliber Computer Corp.'s Voyager Pro is well worth its \$2,755 street price. Caliber provides an infrared port for wireless file transfers and promises free upgrades to Microsoft Windows NT 4.0 when it's released. While the Voyager Pro line targets the 32-bit corporate market, the vendor also sells a Voyager line of PCs offering the gamut of available processors—from the 486 up to the 200-MHz Pentium.

The Voyager Pro—a surprisingly roomy mini-tower—relies on the Intel 450KX chip set, which resides on an Intel Advanced/AU motherboard. Storage is handled by a 2GB Western Digital Caviar EIDE hard disk that spins at 5,200 rpm. The unit also offers a Matrox MGA Millennium graphics card with 2MB of WRAM, a 17-inch GVC 1776LR monitor, two MIDI Land MLI 65 speakers, and a 16-bit Creative Labs ISA sound card that supports wavetable, waveguide, and FM synthesis.

Partly because of its Orion chip set



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and standard fast-page-mode DRAM, the system produced a Winstone 32 score that was barely average; its CPUmark₃₂ score was average. The unit's scores on our Adobe Photoshop tests were below average, but AutoCAD and C Compiler results were on a par with those of the competition. A Toshiba XM-5302B ATAPI CD-ROM drive resulted in the top CD-ROM WinMark 96 score for a unit with a 4X drive; the system's score on this measure surprisingly matched the average score of the tested 8X units.

Caliber's warranty includes two years for parts and one year for labor and on-site service. Toll-free technical support is available during business hours.—*CM*
Voyager Pro. Street price: \$2,755. Caliber Computer Corp., Fremont, CA; 800-748-9834, 510-353-1220; fax, 510-354-2134; www.calibercomp.com. *Circle 449 on reader service card.*

Comtrade Electronic Inc.

Comtrade Wide SCSI Powerstation

The Comtrade Wide SCSI Powerstation is a paradox. For an attractive price of \$3,495, this midsize business system provides some prime components yet dragged during portions of our benchmark testing. The Powerstation line also includes 120- to 166-MHz Pentium PCs aimed at Windows 95 users. Other lines include the 3D Multimedia Screamer, for

the small-office user, and the HyperSpeed Multimedia, for the entry-level multimedia home user.

This Energy Star-compliant system uses an Intel Performance/AV motherboard and Intel's Orion chip set. The unit includes EDO DRAM, although the chip set cannot support its extra features. Other hardware includes a Diamond Stealth64 Video 2001 graphics card with 2MB of EDO DRAM and a 2GB Quantum Atlas Fast/Wide SCSI-2 hard disk with a rotational speed of 7,200 rpm. There's also a DDC1- and DDC2-compliant MAG InnoVision DX17T monitor, as well as a 28.8/14.4-Kbps modem with voice mail capabilities. The Aztech Labs sound card supports wavetable synthesis, while Premier QX-512 speakers deliver clear sound.

Despite an impressive hard disk, poor system optimization yielded a well-below-average score on our Winstone 32 tests. The Adobe Photoshop Gaussian Blur score was above average, though, and the 8X Goldstar CD-ROM drive aided in producing an above-average CD-ROM WinMark 96 score.

Comtrade includes a one-year parts-and-labor warranty, with a year of on-site service. Toll-free technical support is available six days a week. The company will charge \$50 for a Windows NT 4.0 upgrade.—*CM*

Comtrade Wide SCSI Powerstation. Direct price: \$3,495. Comtrade Electronic Inc., City of Industry, CA; 800-969-2123,

818-61-6688; fax, 818-369-1479. www.comtrade-pc.com. *Circle 450 on reader service card.*

CyberMax Computer Inc.

ProMax 200

CyberMax Computer's \$3,899 ProMax 200 offers an impressive array of top-level components for a fair price. The system was a competitive performer on most of our benchmark tests, although it did fall behind on two key measures. CyberMax Computer, an eight-year-old direct mail-order company, markets a full line of entry-level to powerhouse Pentium PCs. The ProMax 200 is the vendor's first entry in a series of Pentium Pro systems for mainstream corporate users.

The ProMax 200's setup was aided by two quick-setup guides: one for the system itself and another for Windows NT 3.51. The company will follow Microsoft's upgrade policy for Windows NT 4.0.

The tested system's mini-tower case housed a Seagate 2GB Fast/Wide SCSI-2 hard disk hooked to an Adaptec AHA 2940W controller, a Diamond Stealth64 Video VRAM graphics card with 2MB of VRAM, a Toshiba 6.7X SCSI CD-ROM drive, Altec Lansing ACS5 speakers, and an Ensoniq SoundscapeVIVO 16-bit wavetable sound card. The ProMax 200 we evaluated also came with a 17-inch MAG InnoVision DX1795 monitor that's both DDC1- and DDC2-compliant.

The CyberMax machine is based on an Intel Performance/AU ATX-style motherboard, with Intel's 450KX chip set. The system posted average scores on our Winstone 32, C Compiler, and Adobe Photoshop tests. It yielded a below-average score on our CPUmark₃₂ test and a below-average timing on the AutoCAD tests, however.

CyberMax backs the ProMax 200 with a 30-day, money-back guarantee and a one-year parts-and-labor warranty, with one year of on-site service. Toll-free telephone technical support is available for extended business hours Monday through Friday and between 9:00 and 5:00 on Saturday.—*Robert S. Anthony*

ProMax 200. Direct price: \$3,899. CyberMax Computer Inc., Allentown, PA; 800-443-9868, 610-770-1808; fax, 800-599-7576; www.cybermax.com. *Circle 451 on reader service card.*

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11.3" SVGA Dual Scan Color Display

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Presentation Port

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Windows 95® Keys

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Ergonomic
Keyboard

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SensPad™
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with Built-In Mic
and Stereo Speakers

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Removable
Hard Disk Drive

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One Type III PC Card
Expansion Slots

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Life with optional second
Lithium Ion Battery

Available with
100, 120 or 133 MHz
Pentium® processor

The new **SENS™ 810**. The keyboard is just one of the features you'll love to get your hands on.

SENS™ 810

PENTIUM® PROCESSOR	100 MHZ	100 MHZ	120 MHZ	133 MHZ	133 MHZ*
RAM	8 MB	8 MB	16 MB	16 MB	16 MB
HDD	810 MB	1.3 GB	1.3 GB	1.3 GB	2.1 GB
DISPLAY	11.3" SVGA Dual Scan Color	12.1" SVGA Active Matrix Color	12.1" SVGA Active Matrix Color	12.1" SVGA Active Matrix Color	12.1" SVGA Active Matrix Color
CD-ROM	4x CD-ROM	6x CD-ROM	6x CD-ROM	6x CD-ROM	6x CD-ROM
BATTERY	Lithium Ion	Lithium Ion	Lithium Ion	Lithium Ion	Lithium Ion
WARRANTY	3 year	3 year	3 year	3 year	3 year
PRICE	\$2,799	\$3,799	\$4,299	\$4,599	\$4,999
BUSINESS LEASE	\$112 per month	\$140 per month	\$159 per month	\$170 per month	\$184 per month

*Model comes standard with a PCMCIA 28.8 Modem/Fax card

SENS™ 800 (not pictured)

PENTIUM® PROCESSOR	100 MHZ	100 MHZ	120 MHZ
RAM	8 MB	8 MB	8 MB
HDD	810 MB	810 MB	1.3 GB
DISPLAY	10.4" Active Matrix Color	10.4" SVGA Active Matrix Color	10.4" SVGA Active Matrix Color
WARRANTY	3 year	3 year	3 year
PRICE	\$1,899	\$1,999	\$2,199
BUSINESS LEASE	\$76 per month	\$80 per month	\$88 per month

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CIRCLE 033 ON READER SERVICE CARD

Dell Computer Corp.

Dimension XPS Pro200n, OptiPlex GXpro 200

Dell Computer Corp. aims at distinctly different users with its \$3,949 Dimension XPS P200n and its \$4,110 OptiPlex GXpro 200. Not surprisingly, the performance leader here is the less expensive system, which the vendor sells as part of its power-user line. The Dimension XPS line is Dell's value-oriented but high-powered small-office/home-office series, while the OptiPlex represents the company's corporate performance series and features built-in networking capabilities.

The tested Dimension XPS P200n came in a well-designed, easy-to-open mini-tower case. It was set up with a 2GB Seagate Fast SCSI-2 hard disk, an NEC 8X CD-ROM drive, a Number Nine Imagine 128 Series 2 graphics card with 4MB of VRAM, and a Creative Labs Sound Blaster FM synthesis sound card. Also included were a copy of Microsoft Office Pro-

SERVICE & RELIABILITY

Dell Computer Corp.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Better than average

fessional for Windows 95, a set of Altec Lansing ACS5 speakers, a U.S. Robotics Sportster 28.8/14.4-Kbps fax modem, and an Adaptec 2940UW Fast/Wide SCSI-2

adapter. A 17-inch Dell UltraScan monitor completes the package.

The DMI-compliant OptiPlex GXpro 200 uses a sculpted desktop case that reveals some intelligent engineering internally. For example, the unit's three PCI and two ISA/PCI slots are on a riser secured to a small metal cage. The cage slides out easily—with all expansion cards in place—once a lever is lifted. The unit's power supply swings up and out of the way to provide clear access to the motherboard.

The unit came with a Seagate Fast ATA-2 hard disk, an NEC 4X ATAPI CD-ROM drive (an 8X drive will be included soon), a Number Nine Imagine 128 Series 2 graphics card with 4MB of VRAM, an integrated FM synthesis audio system with a Creative Labs Vibra 16S chip set, and an integrated 10-Mbps Ethernet connector. Also included were Altec Lansing ACS31 speakers and a subwoofer,



plus a 17-inch Dell UltraScan monitor.

The Dimension bettered its more expensive sibling on all of our tests. The unit posted above-average scores on our Winstone 32 and Adobe Photoshop Gaussian Blur tests. It yielded average timings on our AutoCAD and Adobe Photoshop Lighting Effects tests. The OptiPlex posted an above-average score on our Winstone 32 tests, average timings on our AutoCAD and C Compiler tests, and below-average timings on our Adobe Photoshop Gaussian Blur and Lighting Effects tests.

Dell backs each unit with a three-year-parts, one-year-labor warranty, with one year of on-site service. The OptiPlex also includes a one-year support warranty for Windows NT. The company offers 24-hour, 7-day technical support.—*RSA*

Dimension XPS Pro200n. Direct price: \$3,949. **OptiPlex GXpro 200.** Direct price: \$4,110. Dell Computer Corp., Austin, TX; 800-289-3355, 512-338-4400; fax, 800-727-8320; www.dell.com. Circle 452 on reader service card.

Diamond Technologies Inc.

DT Advance Pro-200

The \$3,595 (street) DT Advance Pro-200, from Diamond Technologies, combines such useful hardware as a modem, good audio, and an Ethernet card with mostly average performance (although its Winstone 32 score was well below par). The company positions the DT Advance as a top-level office workstation and also markets multimedia up-

grade products, as well as Pentium and Pentium Pro PCs, servers, and workstations for business and home users.

Inside the midtower case, the DT Advance offers an ATX-style motherboard, a Seagate Fast SCSI-2 2GB hard disk, a Toshiba 6.7X CD-ROM drive, an STB Powergraph 64 graphics board with 2MB of DRAM, and an Adaptec 2940 SCSI-2 controller. The tested unit also came with powerful JUSTer bookshelf speakers and Diamond Technologies' own WaveStar32 PnP 16-bit wavetable sound card.

The DT Advance was configured with useful communications hardware, including a U.S. Robotics Sportster Vi 28.8/14.4-Kbps data/fax/voice modem and a 3Com EtherLink III 10-Mbps Ethernet card. A 17-inch MAG InnoVision DX1795E monitor rounded out the package.

The unit logged above-average scores on our two Adobe Photoshop tests and on our CD-ROM WinMark 96 tests. Other test scores were average, except for its Winstone 32 score, which was one of the lowest in this roundup.

The unit has a one-year parts-and-labor warranty. A year of on-site service is \$35. No policy was set as of press time regarding Windows NT 4.0 upgrades. Toll-free telephone technical support is offered weekdays during business hours.—*RSA*

DT Advance Pro-200. Street price: \$3,595. Diamond Technologies Inc., Anaheim, CA; 800-989-7253, 714-533-9910; fax, 714-533-7805; www.diamondtech.com. Circle 453 on reader service card.

200-MHz Pentium Pro PCs

DirectWave Inc.

Blue Thunder PN200S

In a field of very similar Pentium Pro PCs, DirectWave manages to set its \$4,099 Blue Thunder PN200S apart by combining a handful of conveniences with strong performance. The Blue Thunder PN200S is aimed at high-end Windows NT users. The Blue Thunder line includes both Pentium and Pentium Pro machines.

The DMI-compliant mini-tower offers features to ease service and setup. Once two screws are removed, the unit's motherboard slides neatly out of the case with all expansion boards in place. The system also comes with an "Easy Startup" video.

The tested unit came with a Matrox MGA Millennium graphics card with 2MB of VRAM, a Creative Labs Sound Blaster AWE32 wavetable sound card, and a Maxtech 33.6/14.4-Kbps fax modem. It also used a Quantum 2GB Fast/Wide SCSI-2 hard disk and a Toshiba 8X CD-ROM drive.

This mix of components worked well for the system, which posted an above-average Winstone 32 score. Its timings on our two Adobe Photoshop tests were also among the best in this roundup. Its CPUmark₃₂, AutoCAD, and C Compiler test scores were average.

The unit came bundled with a 17-inch MAG InnoVision DX1795 monitor, a set of Spacotech headphones, and two Mac-case bookshelf speakers. A copy of Lotus SmartSuite 96 is included in the price of the unit, although we didn't receive one.

DirectWave will follow Microsoft's Windows NT 4.0 upgrade policy. The company offers a three-year parts-and-labor warranty, including one year of on-site service. Toll-free technical support is available six days a week.—RSA

Blue Thunder PN200S. Direct price: \$4,099. DirectWave Inc., Ontario, CA; 800-882-8108, 909-390-8098; fax, 909-390-8061. www.directwave.com. *Circle 454 on reader service card.*

DTK Computer Inc.

Apri-31M/200

DTK Computer's \$3,579 (street) Apri-31M/200 offers an impressive array of components, and it kept pace with the competition on most of our benchmark tests. The Apri-31M/200 is the first in the company's new line of Pentium Pro machines, which is aimed at high-end corporate users. DTK Computer sells through resellers and directly serves corporate and government PC customers.

The tested Apri-31M/200 came with a Quantum 2.4GB Fast ATA-2 hard disk, a Sony 8X ATAPI CD-ROM drive, and a Number Nine Imagine 128 Series 2 graphics board with 4MB of VRAM. Also included were a Creative Labs Sound Blaster AWE32 wavetable sound card, a set of JUSTer speakers, and a MicroScan 17-inch monitor.

Inside, the unit was a bit crowded; some cabling blocked access to the SIMM sockets on the DTK motherboard. But the unit employs quick-release drive bays, which

allow for easy removal of components by simply squeezing a pair of metal tabs.

The system posted average scores on our Winstone 32, AutoCAD, C Compiler, and Adobe Photoshop Gaussian Blur and Lighting Effects measures. The system's CD-ROM WinMark 96 score was below average.

DTK Computer backs the Apri-31M/200 with a two-year parts-and-labor warranty. On-site service is \$50

for one year. The company had no policy as of press time regarding upgrades to Windows NT 4.0 for machines purchased prior to the OS's release. Telephone technical support is available weekdays during business hours.—RSA

Apri-31M/200. Street price: \$3,579. DTK Computer Inc., City of Industry, CA; 800-289-2385, 818-810-0098; fax, 818-810-0090; www.dtk.com. *Circle 455 on reader service card.*

SERVICE & RELIABILITY

DTK Computer Inc.

Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Average

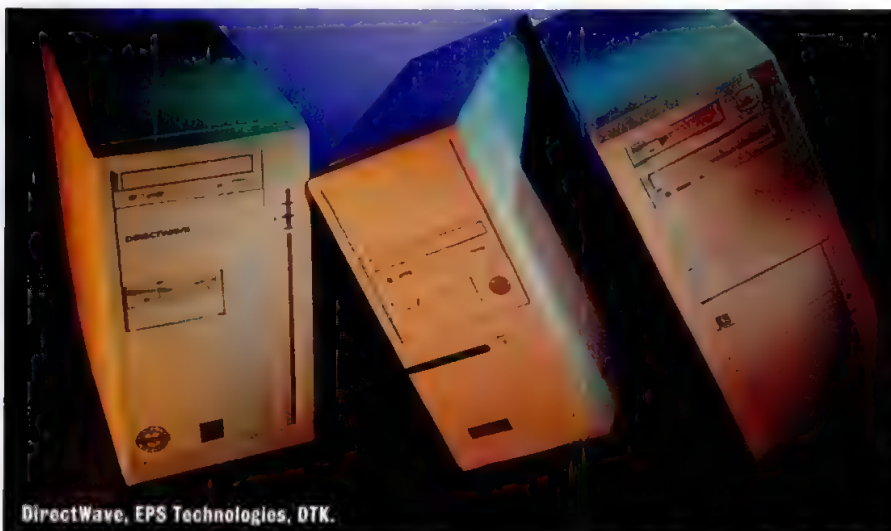
EPS Technologies Inc.

Evolution XL-Pro200

The \$3,195 Evolution XL-Pro200 workstation, from EPS Technologies, offers average performance at a competitive price and a few intriguing hardware features, such as a motherboard that slides out for easy servicing. The unit sits at the top of the vendor's workstation line and targets corporate buyers as well as high-end users. The company's Evolution line includes both Pentium and Pentium Pro workstations; EPS also markets the Apex line of notebooks.

Inside the midtower case is a convenient slide-out motherboard, which you can pull from the case without removing any expansion boards. The unit is configured with a 1.6GB Quantum Sirocco Fast ATA-2 hard disk, an Hitachi 6.7X CDR-7830 ATAPI CD-ROM drive, and a Number Nine Imagine 128 graphics board with 4MB of VRAM.

The system's multimedia hardware includes an Ensoniq SoundScape 16-bit sound card capable of wavetable synthesis, a set of Labtec LS-3211 speakers with Spatializer 3D sound support, and a CTX 1785XA 17-inch monitor.



DirectWave, EPS Technologies, DTK.

The XL-Pro200 did well during testing, earning average scores on our Winstone 32, AutoCAD, C Compiler, CPUmark₃₂, and both Adobe Photoshop tests. The machine's CD-ROM Sequential Read score was also average; its CD-ROM WinMark 96 test score, however, was below average. Its CD-ROM CPU Utilization score was also worse than the average for the tested group.

EPS Technologies offers a three-year-parts, one-year-labor warranty, which includes one year of free on-site service, with its Evolution XL-Pro200. The company says it will follow Microsoft's policy regarding Windows NT 4.0 upgrades. Toll-free telephone technical support is available six days a week.—RSA

Evolution XL-Pro200. Direct price: \$3,195. EPS Technologies Inc., Jefferson, SD; 800-447-0921, 605-966-5586; fax, 605-966-5482; www.epstech.com. Circle 456 on reader service card.

Everex Systems Inc.

STEP DPi/Pro

The \$4,200 (street) STEP DPi/Pro, from Everex Systems, offers a full complement of expansion features that enhance its value and provide competitive performance to boot. This Pentium Pro PC is part of the company's single/dual processor STEP DP line, aimed at the entry-level workstation market. Everex offers a complete selection of desktops, workstations, and servers—from its entry-level Explora line of all-in-one Pentium systems to its quad-processor STEP QP line of Pentium Pro machines.

The unit's midtower case houses a Quantum Atlas 2GB hard disk and a Toshiba 8X CD-ROM drive. Two of four PCI slots in the tested unit were occupied by a Matrox MGA Millennium graphics accelerator board with 4MB of VRAM and an



Adaptec 2940UW Fast/Wide SCSI-2 controller board.

The system also includes a second Pentium Pro processor socket and a SCSI-2 port, and was one of the few units in this story to provide USB ports (two). A Creative Labs Sound Blaster Value 16 sound board capable of FM synthesis, two MLI bookshelf speakers, and a 17-inch Everex monitor complete the hardware package.

On our benchmark tests, the non-DMI-compliant STEP DPi/Pro produced mostly average results. It shone on the Gaussian Blur portion of our Adobe Photoshop testing, faring above the average. Its Winstone 32 score was average, as were its scores on the CPUmark₃₂ tests, the AutoCAD test, the C Compiler test, and the Lighting Effects portion of Adobe Photoshop testing. Its scores on our CD-ROM WinMark 96 and CD-ROM Sequential 16K Read tests were also average, but its CD-ROM

CPU Utilization score was below average.

Everex Systems offers a three-year parts-and-labor warranty with one year of on-site service with the system. Technical support is available 24 hours a day, 7 days a week.—RSA

STEP DPi/Pro. Street price: \$4,200. Everex Systems Inc., Fremont, CA; 800-383-7391, 510-498-1111; fax, 510-683-2186; www.everex.com. Circle 457 on reader service card.

First Computer Systems Inc.

FCS Pentium Pro-200 System

The \$3,199 FCS Pentium Pro-200 System, from First Computer Systems, offers dual-processing capability and makes a visual impression with its large tower case. Its Winstone 32 performance was on a par with that of the competition, but the unit fell behind the pack during Adobe Photoshop testing. The FCS System is at the top of the company's line of Pentium Pro workstations, aimed at high-end corporate users. FCS has been in the PC business for six years and also sells Pentium Pro-based servers.

The FCS machine offers plenty of expansion room, and the spacious case provides clear access to the dual-CPU SuperMicro P6DNF motherboard, with Intel's 440FX chip set. The tested system came with two Pentium Pro CPUs installed, but only one was enabled for our benchmark and performance tests (the price listed above includes one processor only).

The FCS System includes a 2GB Seagate 5,400-rpm Fast ATA-2 hard disk, a Matrox MGA Millennium graphics board with 2MB of VRAM, and a TEAC 6X CD-ROM drive. Also included is an Audio-Drive 16 PnP 16-bit FM synthesis sound card and a KFC 17-inch monitor.

The unit yielded below-average scores on our Adobe Photoshop Gaussian Blur and Lighting Effects tests, and on our CD-ROM WinMark 96 tests. The system posted an average timing on our AutoCAD test and average scores on all other tests, including our Winstone 32 measure.

First Computer backs the unit with a one-year-parts and lifetime-labor warranty. A year of on-site service is \$99. Toll-free technical support is available during extended weekday business hours, and from 10 A.M. to 7 P.M. on Saturdays. The vendor will also offer a free upgrade to Windows NT 4.0.—RSA

FCS Pentium Pro-200 System. Direct price: \$3,199. First Computer Systems Inc., Norcross, GA; 800-325-1911, 770-441-1911; fax, 770-441-1856; www.fcsnet.com. Circle 458 on reader service card.

SERVICE & RELIABILITY

Everex Systems Inc.

Reliability	Worse than average
Repair	Worse than average
Technical support	Worse than average
Percent needing repair	Average

Gateway 2000 Inc.

Gateway G6-200

The Gateway G6-200 (\$3,574) tower system mixes average performance with a good price. Aimed at high-end business users, the G6-200 is at the top of the company's line of Pentium Pro workstations. Gateway 2000 also offers a Family PC line and a Pentium line for the mainstream business user.

The G6-200 is usually advertised by Gateway for a price of \$3,699, which includes a 2GB SCSI hard disk and a 4X SCSI CD-ROM drive, but not a sound card and speakers. If you wish to purchase the machine configured as we tested it, you must specify the components.

The tested unit's large tower case provided seven open drive bays and clear access to the ATX-style motherboard. The system was configured with a Western Digital Caviar 2.4GB EIDE hard disk and a licensed version of the Matrox MGA Millennium graphics board with 4MB of WRAM, and a Creative Labs Sound Blaster 16 FM synthesis sound card. Also included were two Altec Lansing ACS40 speakers with a subwoofer, a Sony 17-inch monitor, and Microsoft Office Professional for Windows 95.

The G6-200 posted average timings on our AutoCAD test and our Adobe Photoshop Lighting Effects and Gaussian Blur tests. It was among the slowest machines here on our C Compiler test, and its Winstone 32 score was average.

SERVICE & RELIABILITY	
Gateway 2000 Inc.	
Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Average

The package includes illustrated component manuals and a fold-out quick-setup guide. Gateway also packs a Gateway System CD-ROM with backup copies of all installed software and drivers.

Gateway will offer free upgrades to Windows NT 4.0 when it ships. The company provides a 30-day money-back guarantee and round-the-clock technical support. The warranty covers three years of parts and one year of labor and on-site service. Three years of on-site service cost \$99. —RSA

Gateway G6-200. Direct price: \$3,574.



Gateway 2000, Hewitt Rand, Hertz, Hewlett-Packard.

Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023; www.gw2k.com. *Circle 459 on reader service card.*

Hertz Computer Corp.

Hertz Z-Pro200

The \$5,495 Hertz Z-Pro200, from Hertz Computer Corp., is marketed as a top-of-the-line corporate office system. Unfortunately, the unit's score on our Winstone 32 test of overall system performance was significantly below par. Moreover, it is among the most expensive units in this roundup. Hertz Computer Corp. is a 14-year old New York City-based manufacturer of PCs, workstations, servers, and notebooks.

The Z-Pro200 is the only unit here configured with an ATI graphics card based on a Mach64 chip set with 4MB of VRAM. The tested system also included a Seagate Hawk ST32430W 2GB Fast/Wide SCSI-2 hard disk hooked to a CMD 16MB caching hard disk controller, a Toshiba XM-3701B 6.7X CD-ROM drive, a 16-bit Creative Labs Sound Blaster Value 16 FM synthesis card, a 17-inch MAG InnoVision DX17F monitor, and MIDI Land MLI-691 speakers.

The Z-Pro200 posted mixed test results. Its Winstone 32 score was the second lowest in this roundup. This score comes despite the machine's caching disk controller and is probably attributable to

the combination of a poorly tuned graphics driver and motherboard memory timings. But its timings on our Adobe Photoshop Gaussian Blur and Lighting Effects tests were above average, and the unit yielded average timings on our AutoCAD and C Compiler tests.

Hertz backs the Z-Pro200 with a one-year parts-and-labor warranty. One year of on-site service costs \$495. The company had not set a Windows NT upgrade policy as of press time. Telephone technical support is available weekdays during regular business hours. —RSA

Hertz Z-Pro200. Direct price: \$5,495. Hertz Computer Corp., New York, NY; 800-232-8737, 212-684-4141; fax, 212-684-3658. *Circle 460 on reader service card.*

Hewitt Rand Corp.

PP200 Mission Critical

Hewitt Rand Corp.'s PP200 Mission Critical, a straightforward and glitzy-free workstation, delivers good performance for an appealing \$3,995. The company markets the unit as a heavy-duty office solution. Hewitt Rand offers a variety of PCs and workstations based on processors from Advanced Micro Devices and Cyrix Corp., as well as from Intel Corp.

The tested PP200 Mission Critical came in a mini-tower case and was configured with a 2GB 7,200-rpm Quantum Fast SCSI-2 hard disk and a Toshiba 6.7X

SUMMARY OF FEATURES

200-MHz Pentium Pro PCs

	Abandon (Intel) Pro 200	AcerPower Pentium Pro	ACMA zPower Pro 200	ACW PC-2000S	ALR Evolution Dual6/200	American MultiSystems InfoGold PP200C	AST Brave MS-T 6200	BDI PP-200NT System
Price of tested configuration	\$3,995 (street)	\$4,148 (street)	\$3,595 (direct)	\$3,398 (street)	\$4,717 (street)	\$3,995 (street)	\$3,300 (street)	\$4,499 (street)
Installed RAM	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB	32MB EDO	32MB EDO	32MB EDO
Hard disk manufacturer and model	Seagate Barracuda ST32550W	Seagate Barracuda ST32550W	Seagate Medalist ST32140A	Seagate Medalist ST32140A	Western Digital Caviar AC31600	Quantum Sirocco 2550AT	Western Digital Caviar AC32500	NEC DSE-2010A
Capacity and interface	2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2	2GB Fast ATA-2	2GB Fast ATA-2	1.5GB EIDE	2.5GB Fast ATA-2	2.4GB EIDE	2GB EIDE
Monitor manufacturer and model	Orchestra Multi-Systems Tube II	Acer 781E	Impression Vienna 17	MAG InnoVision DX1795	MAG InnoVision DX1795	Art Media TG1882	AST Vision 7L	Funai 6DI
Screen diagonal claimed/measured (inches)	17, 15.8	17, 16	17, 16	17, 16.3	17, 16.3	17, 16	17, 15.5	17, 15.8
Graphics adapter	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240	Diamond Stealth64 Video VRAM 3240	Matrox MGA Millennium	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240
Memory	4MB WRAM	2MB VRAM	4MB WRAM	2MB VRAM	4MB VRAM	4MB WRAM	2MB WRAM	4MB VRAM
CD-ROM drive	Toshiba XM-5602B	Acer 685A-007	Toshiba XM-5602B	Toshiba XM-5602B	Sanyo CRD-254P	Toshiba XM-5522B	Toshiba XM-5522B	Hitachi CDR-7930
Speed and interface	8X ATAPI	8X ATAPI	8X ATAPI	8X ATAPI	4X ATAPI	6X ATAPI	6X ATAPI	8X ATAPI
Motherboard Components								
Motherboard manufacturer	SuperMicro	Acer	Intel	Intel	ALR	Intel	Intel	SuperMicro
Chip set manufacturer and model	Intel 440FX	Intel 440FX	Intel 440FX	Intel 450KX	Intel 450KX	Intel 440FX	Intel 440FX	Intel 440FX
BIOS manufacturer and version (or date)	AMI (1995)	Acer 2.0	AMI 1.00.01CS1	AMI 1.00.05.CGD	Phoenix 4.05.5	AMI 1.00.01.CS1	AMI 1.00.01.CS1Q	AMI 0.1
Flash BIOS	■	■	■	■	■	■	■	■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	1GB	192MB	256MB	128MB	512MB	128MB	128MB	1GB
Expansion-bus slots	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	2, 0	2, 1	2, 0	2, 1	2, 0	1, 1	2, 0	4, 0
Internal drive bays (5.25", 3.5")	0, 2	0, 1	0, 0	0, 0	0, 1	0, 2	0, 1	0, 2
Power-supply wattage	300W	200W	200W	235W	315W	235W	200W	395W
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0
Supports EPP/ECP parallel interfaces	■	■	■	■	■	■	■	■
Service and Support								
24-hour, 7-day live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/1 year	3 years/3 years	3 years/1 year	1 year/1 year	5 years/3 years	1 year/1 year	3 years/3 years	1 year/lifetime
On-site service charge (first year)	\$99.00	Included	Included	\$129.95	\$8.95	\$65.00	Included	\$150.00

CD-ROM drive. Also included were a Creative Labs AWE32 16-bit wavetable sound board, a Number Nine Imagine 128 graphics board with 4MB of VRAM, and a PCI-based Adaptec 2940UW Fast/Wide SCSI-2 adapter. The tested system also featured a Viewsonic 17GA 17-inch monitor with a built-in microphone, two built-in speakers, headphones, and external microphone jacks.

The PP200 Mission Critical uses an Intel Performance/AU motherboard with Intel's 450KX core-logic chip set, and standard DRAM. The unit fared well on our benchmark tests, posting above-average times on the Adobe Photoshop Gaussian Blur and CD-ROM

WinMark 96 tests and average marks on the Adobe Photoshop Lighting Effects test. The system yielded average times on our AutoCAD and C Compiler tests. The Winstone 32 result was highly competitive, emerging at the top of the average range.

Hewitt Rand offers a two-year parts-and-labor warranty for the PP200 Mission Critical, with a year of free on-site service. Technical support is available workdays during regular business hours.—RSA

PP200 Mission Critical. List price: \$3,995. Hewitt Rand Corp., Redmond, WA; 206-869-5555; fax, 206-869-5151. *Circle 461 on reader service card.*

Hewlett-Packard Co.

HP Vectra VA 6/200 MT

Hewlett-Packard Co.'s \$4,590 (street) HP Vectra VA 6/200 MT is a part of HP's value Vectra VA line. Unlike the XA line, aimed at network use, or the network-ready, high-performance XU line, VA systems are for mainstream professional and corporate users who need CPU power but not the fanciest features. Based on its average test results, the Vectra VA meets expectations.

The Vectra VA houses an HP motherboard with Intel's Natoma chip set and EDO DRAM in a tool-free mini-tower case. The DMI-compliant system has a

Continues

Caliber Voyager Pro	Comrade Wide SCSI Powerstation	CyberMax ProMax 200	Dell Dimension XPS Pro200m	Dell OptiPlex GXpro 200	Diamond DT Advance Pro-200	DirectWave Blue Thunder PN200S	DTK April 31M/200	EPS Evolution XL-Pro200	Everex STEP DPI/Pro
\$2,755 (street)	\$3,495 (direct)	\$3,899 (direct)	\$3,949 (direct)	\$4,110 (direct)	\$3,595 (street)	\$4,099 (direct)	\$3,579 (street)	\$3,195 (street)	\$4,200 (street)
32MB	32MB EDO	32MB	32MB EDO	32MB EDO	32MB	32MB EDO	32MB EDO	32MB EDO	32MB EDO
Western Digital Caviar AC32100	Quantum Atlas XP32150W	Seagate Hawk ST32430W	Seagate Barracuda ST32550N	Seagate Medalist ST32140A	Seagate Barracuda ST32550N	Quantum Atlas XP32150W	Quantum Sirocco 2550AT	Quantum Sirocco 1700AT	Quantum Atlas XP32150W
2GB EIDE	2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2	2GB Fast SCSI-2	2GB Fast ATA-2	2GB Fast SCSI-2	2GB Fast/Wide SCSI-2	2.4GB Fast ATA-2	1.6GB Fast ATA-2	2GB Fast/Wide SCSI-2
GVC 1776LR	MAG InnoVision DX177	MAG InnoVision DX1795	Dell UltraScan 1728D-LS	Dell UltraScan D1728D-LS	MAG InnoVision DX1795E	MAG InnoVision DX1795	MicroScan SM-5517AP	CTX 1785XA	Everex SRC1702L
17, 15.3	17, 16.3	17, 16.3	17, 15.8	17, 15.8	17, 16	17, 16.3	17, 15.3	17, 16	17, 15.3
Matrox MGA Millennium	Diamond Stealth64 Video 2201	Diamond Stealth64 Video VRAM 3240	Number Nine Imagine 128 Series 2	Number Nine Imagine 128 Series 2	STB PowerGraph 84 PCI	Matrox MGA Millennium	Number Nine Imagine 128 Series 2	Number Nine Imagine 128	Matrox MGA Millennium
2MB VRAM	2MB EDO RAM	2MB VRAM	4MB VRAM	4MB VRAM	2MB DRAM	2MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM
Toshiba XM- 5302B	Goldstar GCD- R500B	Toshiba XM- 3701B	NEC CDR-1400A	NEC CDR-273	Toshiba XM- 3701B	Toshiba XM- 5602B	Sony CDU311	Hitachi CDR-7830	Toshiba XM- 5602B
4X ATAPI	8X ATAPI	6.7X SCSI-2	8X ATAPI	4X ATAPI	6.7X SCSI-2	8X ATAPI	8X ATAPI	6.7X ATAPI	8X ATAPI
Intel	Intel	Intel	Intel	Dell	Intel	ASUSTek	DTK	BCM	FIC
Intel 450MX	Intel 450MX	Intel 450MX	Intel 440FX	Intel 440FX	Intel 450MX	Intel 440FX	Intel 440FX	Intel 440FX	Intel 440FX
AMI 1.00.06.CG0	AMI 1.00.06	AMI 1.00.03.CG0	AMI/Dell A03	Phoenix 1.10 A00	AMI 1.00.06.CG0	Award 4.51PG	AMI (1995)	AMI (1995)	AMI (1995)
■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	128MB	128MB	128MB	256MB	384MB	256MB	512MB
3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	1 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 PCI, 2 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 1 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA
3, 0	2, 1	2, 0	1, 2	1, 0	3, 0	2, 1	3, 0	2, 1	2, 1
0, 1	0, 0	0, 1	0, 1	0, 1	0, 1	0, 0	0, 3	0, 1	1, 0
250W	235W	200W	200W	300W	250W	235W	250W	200W	235W
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
2 years/1 year Included	1 year/1 year Included	1 year/1 year Included	3 years/1 year Included	3 years/1 year Included	1 year/1 year \$35.00	3 years/3 years Included	2 years/2 years \$50.00	3 years/1 year Included	3 years/3 years Included

large plastic housing to direct air from a fan directly to the processor and heat sink. The tested system was equipped with two Quantum Fireball 1.2GB 5,400-rpm Fast ATA-2 hard disks. (By the time you read this, the unit will be sold with a 2.5GB Quantum hard disk, and the price will be \$95 lower.) The system also included a Matrox MGA Millennium graphics card with 2MB of VRAM, a 17-inch HP monitor, a Creative Labs 16-bit Sound Blaster audio card, and an 8X Hitachi CD-ROM drive, which was responsible for the unit's above-average CD-ROM WinMark 96

score. Other test scores were average, except for its Photoshop results, which were below average.

The Vectra VA ships with a free upgrade coupon for Windows NT 4.0 when it becomes available. A three-year warranty with first-year on-site service is provided. Technical support is offered weekdays during extended business hours, but special support programs are available.—Bruce Brown

HP Vectra VA 6/200 MT. Street price: \$4,590. Hewlett-Packard Co., Palo Alto, CA; 800-322-4772; fax, 800-333-1917; www.hp.com. Circle 462 on reader service card.

SERVICE & RELIABILITY

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HiQuality Computer Systems

Venus Station

HiQuality Computer Systems targets the Venus Station (\$3,599, direct price) at power users demanding top components as well as superior price and performance. Intended for people who need great 32-bit and adequate 16-bit performance from a Pentium Pro PC, the Venus Station delivers, ably meeting its audience's needs. The company had not determined its Windows NT 4.0 upgrade plan at press time.

The Venus Station comes in a midsize tower case; it supports DMI, but the reviewed unit had no MIF browser. The



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45GB Ultra Disk Array	RAID 5 2GB	RAID 5 12GB	Storage Solutions	Tape Solutions
10 Bay Cabinet Designed for Ultra Wide Drives	15 Bay Tower	7 Bay Tower	Specials:	Specials:
Hot Swappable Drives	Hot Swappable Drives	Hot Swappable Drives	Extended 4GB 7200 SCSI Wide Drive \$943	50GB Extended Tape Drive 3mb/s Streamlined Transfer Rate \$3600
Sensor Monitoring Panel: Internal Temp Status of Power, Fans and Drives Alarm Feature	RAID 5 5 Channel Controller Able to Upgrade to Higher RAID 5 Controllers	RAID 5 2 Channel Controller Q 3 4GB 7200 RPM Drives	Extended 2GB Ultra SCSI Wide Drive \$495	64GB Dat Auto Loader \$3570
N+1 300 Watt Power Supplies	Q 5 4GB 7200 RPM Drives	Two 300 Watt Redundant Power Supplies	We can configure any subsystem for any platform from 2GB to Terabytes	100GB DLT Library \$6100
Q5 9.1GB 7200 RPM Ultra Wide HD5	Two 300 Watt Redundant Power Supplies	\$647 for your custom RAID solution from 12GB to terabytes call		Sony SDX 300 25GB Fastest Tape Drive Made With SCSI 2 Fast Wide Interface \$3420
\$10750	\$10200			Sony SDT 7000 8GB Fastest DLT Model \$815

AT&T on-site and 4 year extended warranties are available. Lease options available. Returns may be subject to restocking fee. RMA# must be acquired. Some devices have not been approved by the Federal Communications Commission. These devices are not, and may not be, offered for sale or lease, or sold or leased until the approval of the FCC has been obtained. GSA Schedule #GS-36F-316802

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2 Intel Pentium Pro® Processors Exp. to 4	Expandable to 2 new Pentium Pro Processors Built-in Expandability with SMP Master Chipset	1 Intel Pentium® Pro Processor	1 Intel Pentium® 200MHz Processor, Upgradable to 2 CPUs	Imagine 128, Fastest Graphics, Drive Supports Intel Pentium 200, 166MHz Pentium Processor	256 Bit Bus
64MB of ECC 4 way Interleaved Memory to 1GB	1 Intel Pentium® Pro 200 Processor	32MB of 60 MOS EDO RAM	512K Pipeline Cache	1 Intel Pentium® 200MHz Processor, Upgradable to 2 CPUs	1MB SRAM Cache
Slots (6) PCI, (4) ISA	32MB of 60 MOS RAM Expandable To 512MB	Expandable to 128MB	32MB EDO	Titan II Chipset	1 Dec 433 MHz Alpha CPU
Adaptec 2940 UW	ECC Supported	ECC Supported	3 4GB 7200 RPM Removable HD	1.6MB RAM Expandable to 256MB	64MB RAM to 1GB
9.1GB 7200RPM	Imagine 128 Series II 4 MB VRAM	SLOTS: (4) PCI, (3) ISA	RAID 5 Controller	Slots (4) PCI, (4) ISA	
Ultra Wide HD	Open Slots: (3) PCI, (1) ISA	3.2GB 5400 RPM 9.5ms HD	Slots (4) PCI, (4) ISA	Sony 8x CD-ROM	Elec. Glavin 8 Graphics
8x CD-ROM	Adaptec 2940 Ultra Wide Controller	#9 2MB VRAM Video	10 Bay Tower 300 Watt Redundant Power Supplies	28.8 Floppy, Mouse	4GB 7200 RAM SCSI wide HD
#9 2MB DRAM Video	16 Bit Sound Card	16 Bit Sound Card	Sony 8x CD-ROM	Imagine 128 Series II 128 Bit "3D" 4MB VRAM Video	
RGB DMT Drive	4.1GB Ultra Wide SCSI HD (8.5ms)	2.88 Floppy, Keyboard, Mouse	Keyboard, Mouse	2940 UW	
Quad PCI Ethernet 10/100	Intel 10/100 Ethernet			2.1GB Ultra SCSI Wide HD (8.5ms)	
Floppy, Keyboard and Mouse	Sony 8x CD-ROM			32 PMP Sound	Slots 3PCT 2 ISA
12 Bay Tower 450 Watt Power	Keyboard, 2.88 Floppy, Mouse			Midtower Case	Tower 300 Watt
	Hardware Monitoring Utility			1400T Monitor	
	Tower Case 300 Watt	Midtower			
\$10700	\$3473	\$2201	\$6899	\$3478 Single Processor Solution \$3203	\$7990

ATA/AT on-site and 4 year extended warranties are available. Lease options available. Returns may be subject to reworking fee. RAMM must be acquired. Some devices have not been approved by the Federal Communications Commission. These devices are not, and may not be, allowed for sale or lease, or sold or leased until the approval of the FCC has been obtained. GSA Schedule #28-SF-3189D

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CIRCLE 309 ON READER SERVICE CARD



SUMMARY OF FEATURES

200-MHz Pentium Pro PCs

■ YES ■ NO

Products listed in alphabetical order

	FCS Pentium Pro-200 System	Gateway G6-200	Hertz Z-Pro200	Hewlett-Packard Mission Critical	Hewlett-Packard Vectra VA 6/200 MT	HiQ Venus Station	Maximus Magna Artist Pro	Mega Double Impact Pentium Pro 200
Price of tested configuration	\$3,199 (direct)	\$3,574 (direct)	\$5,495 (direct)	\$3,995 (street)	\$4,590 (street)	\$3,599 (direct)	\$4,799 (direct)	\$4,200 (street)
Installed RAM	32MB EDO	32MB EDO	32MB	32MB	32MB EDO	32MB EDO	32MB EDO	32MB EDO
Hard disk manufacturer and model	Seagate Medalist ST32140A	Western Digital Caviar AC32500	Seagate Hawk ST32430W	Quantum Atlas XP32150	Quantum Fireball 1280AT	IBM DFHS-S2W	Quantum Atlas XP32150W	Quantum Atlas XP32150W
Capacity and interface	2GB Fast ATA-2	2.4GB EIDE	2GB Fast/Wide SCSI-2	2GB Fast SCSI-2	Two 1.2GB Fast ATA-2	2.1GB Fast SCSI-2	2GB Fast/Wide SCSI-2	2GB Fast/Wide SCSI-2
Monitor manufacturer and model	KFC CB1716CL	Sony Vivitron 177B	MAG InnoVision DX17F	Viewsonic 17GA	HP Ultra VGA 1280	TEAC DM-71F	MAG InnoVision DX17T	Iiyama MF-8617E
Screen diagonal claimed/measured (inches)	17, 16	17, 16.3	17, 16	17, 16.3	17, 15.8	17, 16	17, 16.3	17, 15.6
Graphics adapter	Matrox MGA Millennium	Matrox MGA Millennium	ATI Mach64	Number Nine Imagine 128	Matrox MGA Millennium	Matrox MGA Millennium	Number Nine Imagine 128 Series 2	Matrox MGA Millennium
Memory	2MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	2MB VRAM	2MB VRAM	4MB VRAM	4MB VRAM
CD-ROM drive	TEAC CD-56E	Toshiba XM-5602B	Toshiba XM-3701B	Toshiba XM-3701B	Hitachi CDR-7930	Toshiba XM-5602B	Plexitor PX-83CS	Toshiba XM-3701B
Speed and interface	6X ATAPI	8X ATAPI	6.7X SCSI-2	6.7X SCSI-2	8X ATAPI	8X ATAPI	8X SCSI-2	6.7X SCSI-2
Motherboard Components								
Motherboard manufacturer	SuperMicro	Intel	ASUSTek	Intel	HP	ASUSTek	SuperMicro	SuperMicro
Chip set manufacturer and model	Intel 440FX	Intel 440FX	Intel 450IX	Intel 450IX	Intel 440FX	Intel 440FX	Intel 440FX	Intel 440FX
BIOS manufacturer and version (or date)	AMI 0.1	AMI 1.00.02CS1T	AMI 0105	AMI 1.00.06.CG	Phoenix 4.05.1	Award 4.51PG	AMI (7/15/95)	AMI (1995)
Flash BIOS	■	■	■	■	■	■	■	■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	1GB	128MB	512MB	256MB	192MB	256MB	1GB	1GB
Expansion-bus slots	4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 2 PCI, 2 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI
Accessible drive bays (5.25", 3.5")	4, 1	2, 0	1, 0	2, 0	2, 0	2, 1	4, 0	2, 0
Internal drive bays (5.25", 3.5")	1, 0	0, 5	0, 0	0, 1	0, 0	0, 1	0, 1	0, 1
Power-supply wattage	300W	180W	200W	180W	160W	235W	250W	250W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0
Supports EPP/ECP parallel interfaces	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
24-hour, 7-day live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/lifetime	3 years/1 year included	1 year/1 year	2 years/2 years included	3 years/3 years included	1 year/2 years	4 years/4 years included	2 years/2 years
On-site service charge (first year)	\$99.00		\$495.00			\$97.95 (2 years)		N/A

N/A—Not applicable: The product does not have this feature.

unit's motherboard is from ASUSTek and uses the Intel 440FX chip set. The tested system had an IBM 2.1GB 7,200-rpm Fast/Wide SCSI-2 hard disk, an Adaptec 2940W disk controller, a Matrox MGA Millennium graphics card with 2MB of VRAM, and a TEAC 17-inch monitor. These components worked well together, earning the unit an above-average Winstone 32 score. The machine also excelled on the Adobe Photoshop Gaussian Blur test.

Other hardware features included with the Venus Station are a Sound Blaster AWE-32 audio card, Yamaha YST-M10 speakers, and an 8X Toshiba CD-ROM drive that helped the machine score

above the average on the CD-ROM WinMark 96 tests. The unit also includes a Microsoft Natural Keyboard.

The company provides a one-year-parts, two-year-labor warranty, with two years of on-site service available for \$97.95. It also offers a corporate service hot line for large accounts, which results in quick referral to the proper in-house specialists. Technical support is available during weekday business hours and for limited hours on Saturdays.—BB

Venus Station. Direct price: \$3,599. Hi-Quality Computer Systems, Sunnyvale, CA; 800-827-5836, 408-245-5836; fax, 408-245-3108; www.hiq.com. Circle 463 on reader service card.

Maximus Computers Inc.

Magna Artist Pro

Maximus Computers' Magna Artist Pro (\$4,799 direct) is a mainstream Pentium Pro system meant for midsize corporations. The system is well equipped, earned good test results, and includes a longer-than-average warranty. Its price, though, might cause some buyers to seek a less expensive system with comparable performance.

The Artist Pro utilizes a Super Micro motherboard with Intel's 440FX chip set and EDO DRAM in a large, full-tower case. The unit is DMI-compliant, although the vendor does not provide a

Continues

PC MAGAZINE
THE MONTHLY EDITOR'S CHOICE

Micro Express MicroFlex- PCI/Pro200	Micron Millennia Plus Pro200	Mitsuba Premier- Pro 200	Multwave Pro Power	NEC PowerMate Pro 2200	Polywell Poly P6-200N	ProGen Nova II 200MHz	Quantex Q6/200 WS-2	Reeson Square 6 NA/VA	Robotech Cobra XLP Pro 200
\$2,695 (direct)	\$4,348 (direct)	\$3,799 (street)	\$3,395 (direct)	\$3,471 (street)	\$4,250 (direct)	\$3,449 (direct)	\$3,499 (direct)	\$2,975 (direct)	\$3,799 (street)
32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB EDO	32MB
Quantum Sirocco 1700AT	Quantum Grand Prix XP32151	Quantum Atlas XP32150	Quantum Atlas XP32150W	IBM DAQA- 32180	Seagate Hawk ST32155W	Western Digital Caviar AC32500	Seagate Hawk ST32430W	Quantum Sirocco 2550AT	Seagate Medalist ST32140A
1.6GB Fast ATA-2	2GB Ultra SCSI	2GB Ultra SCSI	2GB Fast/Wide SCSI-2	2GB ATA-3	2GB Ultra SCSI	2.4GB EIDE	2GB Fast/Wide SCSI-2	2.4GB Fast ATA-2	2GB Fast ATA-2
GVC M1766LR	Micron LM-1764	Hyundai Deluxe Scan 17	AcerView 761e	NEC MultiSync M700	Sampo Alphascan 17mx	MAG InnoVision DX1795	MAG InnoVision DX17T	Samsung SyncMaster 17GLsi	Princeton Ultra 17+
17, 15.8	17, 15.5	17, 15.8	17, 15.8	17, 15	17, 15.8	17, 16.3	17, 16.3	17, 15.8	17, 16.3
Matrox MGA Millennium	Number Nine Imagine 128 Series 2	STB Lightspeed 128	Matrox MGA Millennium	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240	Matrox MGA Millennium	Number Nine Imagine 128	Matrox MGA Millennium	Number Nine Motion 771
2MB VRAM	4MB VRAM	2MB MDRAM	2MB VRAM	4MB VRAM	2MB VRAM	4MB VRAM	2MB VRAM	4MB VRAM	2MB VRAM
Toshiba XM- 5522II	Plextor PX-83CS	Samsung SCR- 830	Sony CDV76S	NEC CDR-1400A	Toshiba XM- 3701B	Pinnacle Micro 10Xtreme	Toshiba XM- 3701B	TEAC CD-56E	Acer 685A-003
6X ATAPI	8X SCSI-2	8X ATAPI	4X SCSI-2	8X ATAPI	6.7X SCSI-2	10X ATAPI	6.7X SCSI-2	6X ATAPI	8X ATAPI
Intel	Intel	Mitsuba	Intel	Intel	SuperMicro	Intel	Intel	Intel	Intel
Intel 450KX	Intel 440FX	Intel 440FX	Intel 450KX	Intel 440FX	Intel 440FX	Intel 440FX	Intel 450KX	Intel 440FX	Intel 450KX
AMI 1.00.06.CG0	AMI 0.01.03.CS1	AMI (1995)	AMI 1.00.06.CG0	AMI 0.02.01CS1K, beta 1.02	AMI (7/15/95)	AMI 1.00.01	AMI 1.00.03.CG0	AMI 1.00.03.CS1	AMI 1.00.06.CG0
■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■	■	■
128MB	256MB	512MB	128MB	128MB	1GB	512MB	128MB	256MB	128MB
2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
2, 1	1, 2	3, 0	2, 1	2, 0	6, 0	2, 1	3, 0	2, 0	2, 0
0, 1	1, 0	0, 3	0, 1	0, 1	1, 0	0, 0	0, 1	0, 1	0, 0
235W	250W	250W	235W	200W	300W	235W	200W	200W	180W
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
2 years/2 years	3 years/1 year	2 years/2 years	1 year/lifetime	3 years/3 years	2 years/5 years	3 years/3 years	3 years/3 years	6 years/6 years	3 years/1 year
\$50.00	Included	Included (2 years)	Included	Included (1 year)	\$75.00	Included	Included	\$49.00	Included

MIF browser.

A 2GB Quantum Fast/Wide SCSI-2 7,200-rpm hard disk, an Adaptec 2940UW adapter, and a Number Nine Imagine 128 Series 2 graphics card with 4MB of VRAM helped secure a Winstone 32 score at the top of the average range. The system excelled on our Adobe Photoshop Gaussian Blur test, however, producing a higher-than-average result.

Other features include a MAG InnoVision DX-17T monitor, a Plextor 8X CD-ROM drive (which helped yield an above-average CD-ROM WinMark 96 score), a 16-bit Sound Blaster audio card, and JUSTer SP980 speakers. A U.S.

Robotics Sportster PnP 33.6/14.4-Kbps modem and Microsoft Office Professional are also bundled.

The Artist Pro has a four-year warranty, with on-site service included for all four years. The company also offers 24-hour, 7-day telephone technical support and will devise special service and support programs for large corporate accounts. The vendor will also provide free upgrades to Windows NT 4.0 when it is available.—BB

Magna Artist Pro. Direct price: \$4,799. Maximus Computers Inc., Monrovia, CA; 800-888-6294, 818-305-5925; fax, 818-357-9140; www.maximuspc.com. Circle 464 on reader service card.

Mega Computer Systems

Double Impact Pentium Pro 200

Mega Computer Systems' Double Impact Pentium Pro 200 delivers competitive Pentium Pro performance for \$4,200 (street). The system comes with a better-than-average set of components, such as a DSVD modem. The unit is targeted at Fortune 1000 companies, but Mega is also finding a market with small- to medium-size businesses, particularly for desktop publishing and CAD/CAM applications.

The combination of a 2GB Quantum

Pentium® Pro performance at Pentium prices!

\$2,199



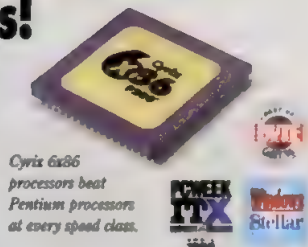
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Cyrix 6x86-P200 PC Option I

- Cyrix 6x86-P200* processor, 256K synchronous pipelined-burst cache
- 16MB Performance EDO DRAM (256MB max)
- 64-bit PCI video, 2MB 45ns EDO DRAM
- 2.5GB EIDE hard drive, 3.5" floppy
- 8X EIDE CD-ROM drive
- Sound Blaster™ 16 stereo sound, 2 piece stereo speaker set
- 15", 1280NI, .28mm monitor
- Minitower or desktop case
- 104-key keyboard, two button mouse
- Lotus® SmartSuite® 96 CD
- CompuServe® CD - Trial membership
- MS Windows® 95 pre-loaded w/Plus Pack
- 3-year limited system warranty

\$2,199

Business/Consumer Lease \$87/mo.

CompuServe



Cyrix 6x86-P200 PC Option II

- Cyrix 6x86-P200* processor, 256K synchronous pipelined-burst cache
- 16MB Performance EDO DRAM (256MB max)
- Matrox® MGA™ Millennium video, 2MB WRAM
- 2.5GB EIDE hard drive, 3.5" floppy
- 8X EIDE CD-ROM drive
- Sound Blaster AWE32™ wavetable sound
- 17", 1280NI, .26mm monitor
- Hi-fidelity multimedia speaker system w/subwoofer
- 28.8 fax/modem/telephone answering device
- Minitower or desktop case
- 104-key keyboard, two button mouse
- Lotus® SmartSuite® 96 CD
- CompuServe® CD - Trial membership
- MS Windows® 95 pre-loaded w/Plus Pack
- 3-year limited system warranty

\$2,799

Business/Consumer Lease \$110/mo.

Cyrix 6x86-P200 PC Option III

- Cyrix 6x86-P200* processor, 256K synchronous pipelined-burst cache
- 32MB Performance EDO DRAM (256MB max)
- Matrox® MGA™ Millennium video, 2MB WRAM
- 4GB Fast SCSI-2 hard drive, 3.5" floppy
- Adaptec 29400U Ultra SCSI controller
- 8X EIDE CD ROM drive
- Sound Blaster AWE32™ wavetable sound
- Hi-fidelity multimedia speaker system w/subwoofer
- 17", 1280NI, .26mm monitor
- Minitower or desktop case
- 104-key keyboard, two button mouse
- Lotus® SmartSuite® 96 CD
- CompuServe® CD - Trial membership
- MS Windows® 95 pre-loaded w/Plus Pack
- 3-year limited system warranty

\$3,939

Business/Consumer Lease \$151/mo.

Cyrix 6x86-P166 PC Option I

- Cyrix 6x86-P166* processor, 256K synchronous pipelined-burst cache
- 16MB Performance EDO DRAM (128MB max)
- 2.5GB EIDE hard drive, 3.5" floppy
- 64-bit PCI video, 2MB 45ns EDO DRAM
- 8X EIDE CD-ROM drive
- Sound Blaster™ 16 stereo sound, 2 piece stereo speaker set
- 15", 1280NI, .28mm monitor
- Minitower or desktop case
- 104-key keyboard, two button mouse
- Lotus® SmartSuite® 96 CD
- CompuServe® CD - Trial membership
- MS Windows® 95 pre-loaded w/Plus Pack
- 3-year limited system warranty

\$2,099

Business/Consumer Lease \$83/mo.

Cyrix 6x86-P166 PC Option II

- Cyrix 6x86-P166* processor, 256K synchronous pipelined-burst cache
- 16MB Performance EDO DRAM (128MB max)
- 2.5GB EIDE hard drive, 3.5" floppy
- Matrox® MGA™ Millennium video, 2MB WRAM
- 8X EIDE CD-ROM drive
- Sound Blaster AWE32™ wavetable sound
- 17", 1280NI, .26mm monitor
- Hi-fidelity multimedia speaker system w/subwoofer
- 28.8 fax/modem/telephone answering device
- Minitower or desktop case
- 104-key keyboard, two button mouse
- Lotus® SmartSuite® 96 CD
- CompuServe® CD - Trial membership
- MS Windows® 95 pre-loaded w/Plus Pack
- 3-year limited system warranty

\$2,699

Business/Consumer Lease \$106/mo.

CIRCLE 343 ON READER SERVICE CARD

Cyrix 6x86-P150 PC

- Cyrix 6x86-P150* processor, 256K synchronous pipelined-burst cache
- 16MB Performance EDO DRAM (128MB max)
- 1.6GB EIDE hard drive, 3.5" floppy
- 64-bit PCI video, 2MB 45ns EDO DRAM
- 8X EIDE CD-ROM drive
- Sound Blaster™ 16 stereo sound 2 piece stereo speaker set
- 15", 1280NI, .28mm monitor
- Minitower or desktop case
- 104-key keyboard, two button mouse
- Lotus® SmartSuite® 96 CD
- CompuServe® CD - Trial membership
- MS Windows® 95 pre-loaded w/Plus Pack
- 3-year limited system warranty

\$1,899

Business/Consumer Lease \$75/mo.



1-800-340-7795

<http://www.cyrix.com>



SUMMARY OF FEATURES

200-MHz Pentium Pro PCs

PC MAGAZINE
EDITORS' CHOICE

■ YES ■ NO

Products listed in alphabetical order

	SAG STA Pro 200 Desktop	Sys Performance Pro 200	Tegram Thunderbolt Corporate T6	Total Peripherals Lightning	Unisys Aquanta DM/6	Unitek UT-PP200 Commando
Price of tested configuration	\$2,999 (direct)	\$4,176 (direct)	\$3,445 (direct)	\$3,159 (direct)	\$5,509 (street)	\$2,995 (street)
Installed RAM	32MB EDO	32MB	32MB	32MB	32MB	32MB EDO
Hard disk manufacturer and model	Seagate Barracuda ST32550W	Quantum Fireball 1280AT	Quantum Atlas XP32150W	Seagate Medalist ST32140A	Seagate Hawk ST32430ND	Western Digital Caviar AC31600
Capacity and interface	2GB Fast/Wide SCSI-2	Two 1.2GB Fast ATA-2	2GB Fast/Wide SCSI-2	2GB Fast ATA-2	2GB Fast SCSI-2	1.5GB EIDE
Monitor manufacturer and model	MAG InnoVision DX17T	MAG InnoVision DX1795	MAG InnoVision DX1795	Acer 7178IE	Unisys EVG174-COL	Viewsonic 17GA
Screen diagonal claimed/measured (inches)	17, 16.3	17, 16.3	17, 16.3	17, 15.8	17, 15.5	17, 16.3
Graphics adapter	Matrox MGA Millennium	Matrox MGA Millennium	Matrox MGA Millennium	Diamond Stealth64 Video VRAM 3240	Number Nine Imagine 128	Matrox MGA Millennium
Memory	2MB WRAM	2MB WRAM	2MB WRAM	2MB VRAM	4MB VRAM	4MB WRAM
CD-ROM drive	Toshiba XM-5602B	Toshiba XM-5602B	Toshiba XM-3701B	Acer 685A-003	Toshiba XM-5401B	Sanyo CRD-256P
Speed and interface	8X ATAPI	8X ATAPI	6.7X SCSI-2	8X ATAPI	4X SCSI-2	6X ATAPI

Motherboard Components

Motherboard manufacturer	AMI	ASUS/tek	Intel	ASUS/tek	FIC	Intel
Chip set manufacturer and model	Intel 440FX	Intel 450KX	Intel 450KX	Intel 450KX	Intel 450KX	Intel 450KX
BIOS manufacturer and version (or date)	AMI DMI 2.0	AMI (10/10/94)	AMI 1.00.06.CGD	AMI 0104 (1994)	Phoenix 4.05	AMI 1.00.05CGD
Flash BIOS	■	■	■	■	■	■
Multiprocessor socket	■	■	■	■	■	■

Expandability

Maximum RAM	128MB	512MB	128MB	512MB	256MB	128MB
Expansion-bus slots	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 0	2, 0	2, 1	2, 1	2, 0	2, 1
Internal drive bays (5.25", 3.5")	0, 3	0, 1	0, 0	0, 1	0, 2	0, 1
Power-supply wattage	300W	250W	235W	200W	200W	235W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1
Supports EPP/ECP parallel interfaces	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

Service and Support

24-hour, 7-day live technical support	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/2 years	1 year/1 year	1 year/1 year	2 years/2 years	3 years/3 years	1 year/1 year
On-site service charge (first year)	\$70.00	\$95.00	\$49.00	Included	Included	\$75.00

7,200-rpm Fast/Wide SCSI-2 hard disk with an Adaptec 2904W controller, along with a Matrox MGA Millennium graphics card with 4MB of WRAM, helped the unit post an above-average score on the Adobe Photoshop Gaussian Blur test. Its Winstone 32 result was at the high end of the average range. A Toshiba 6.7X CD-ROM drive helped the unit earn an above-average CD-ROM WinMark 96 score.

This machine has a SuperMicro motherboard, which offers a second CPU socket; it uses Intel's 440FX chip set. The system is DMI-compliant. Other components include a Danpex 10-Mbps Ethernet card and a 33.6/14.4-Kbps DSVD modem with full-duplex speakerphone, caller ID, and distinctive-ring support. An Iiyama 17-

inch monitor, a Creative Labs Sound Blaster wavetable audio card, and Kingtex speakers complete the package. An internal detachable case with two additional 3.5-inch bays is also standard, although it was not sent with the system we tested.

Corporate customers who buy Pentium Pro PCs with Windows NT reach senior support technicians; other special support programs can be arranged. The unit has a two-year warranty; telephone technical support hours, however, are relatively short: 9:00 A.M. to 4:30 P.M., Monday through Friday.—BB

Double Impact Pentium Pro 200. Street price: \$4,200. Mega Computer Systems, San Diego, CA; 800-338-6628, 619-487-8888; fax, 619-485-1518; www.megacs.com. Circle 465 on reader service card.

Micro Express

MicroFlex-PCI/Pro200

Micro Express's MicroFlex-PCI/Pro200 sells for an eye-opening \$2,695 (direct) and is backed by mostly average test results. Intended as a reasonably high-performance machine for corporate and small-office/home-office users, the system sells with Windows 95 preinstalled.

The MicroFlex's midtower case holds an Intel ATX motherboard with the Intel Orion chip set. The tested system came with EDO DRAM, even though the Orion chip set does not support EDO's extra features. The system is DMI-compliant, but no MIF browser was included.

Using a 1.7GB 4,500-rpm EIDE Quantum hard disk, the unit posted an average

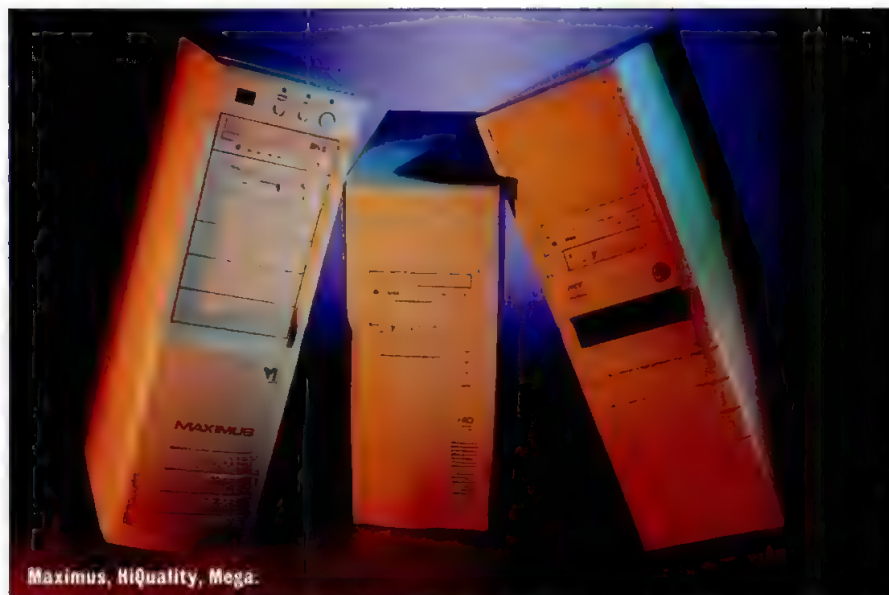
Ends

Vektron Optima Pro Station	Xi Pro200 MTower DP/SP	Zenon Optima Pro Station
\$2,995 (direct)	\$4,549 (direct)	\$3,499 (direct)
32MB EDO	32MB EDO	32MB
Western Digital Caviar AC32500	IBM DFBS-S2W	Seagate Barracuda ST32550W
2 4GB EIDE	2 2GB Ultra SCSI	2GB Fast/Wide SCSI-2
MAG InnoVision DX700T	Viewsonic Optiquest V775	MAG InnoVision DX1795
17, 16.3	17, 16	17, 16.3
Diamond Stealth 3D 2000	Matrox MGA Millennium	Matrox MGA Millennium
2MB EDO RAM	4MB WRAM	2MB WRAM
Toshiba XM-5602B	Toshiba XM-3701B	TEAC CD-56S
8X ATAPI	6 7X SCSI-2	6X SCSI-2
SuperMicro	Tyan	SuperMicro
Intel 440FX	Intel 440FX	Intel 440FX
AMI (7/15/95)	Award 4.51PG	AMI 0507961540
■	■	■
■	■	■
1GB	1GB	1GB
4 ISA, 4 PCI	2 ISA, 4 PCI, 1 PCI/ISA	4 ISA, 4 PCI
4, 0	1, 1	5, 1
3, 0	0, 1	0, 2
300W	235W	240W
1, 2, 1	1, 2, 1	1, 2, 0
■ ■	■ ■	■ ■
■	■	■
1 year/lifetime	3 years/3 years	1 year/lifetime
Included	Included	\$160.00

Winstone 32 score. A below-average score on the Adobe Photoshop Lighting Effects test can be partly attributed to the Matrox MGA Millennium graphics accelerator card, which was loaded with only 2MB of WRAM (many of the other tested systems with the same card had 4MB). The system also posted a below-average score on the CD-ROM Sequential 16K Read test. Other test scores were average.

The tested unit included a 17-inch GVC monitor, a Toshiba 6X CD-ROM drive, an ESS audio card, and small Micro Express SL-10 speakers.

Micro Express will make special support arrangements for corporate customers, including provisions for on-site support staff. The warranty covers parts and labor for two years; on-site service is available for \$50 for the first year. The



company guarantees 24-hour replacement in the event of a board failure and provides 24-hour, 7-day technical support. At press time, the company had not yet formulated a Windows NT 4.0 upgrade pricing policy.—BB

MicroFlex-PCI/Pro200. Direct price: \$2,695. Micro Express, Irvine, CA; 800-989-9900, 714-852-1400; fax, 714-852-1225; www.wpages.com/microexpress/. Circle 466 on reader service card.

Micron Electronics Inc.

Millennia Plus Pro200

Based on its strong Winstone performance and its high-end components, Micron Electronics' Millennia Plus Pro200 (\$4,348) is a great choice for companies looking to move to Windows NT. The unit is targeted at corporate users, especially those using 32-bit applications or planning to switch to 32-bit programs soon. Though the unit was originally intended as a high-end graphics-capable system for CAD or engineering applications, Micron is finding widespread corporate demand for such Pentium Pro PCs.

The Millennia posted a highly competitive score on our Winstone 32 measure thanks to some high-powered components: a 2GB Quantum Grand Prix 7,200-rpm Ultra SCSI hard disk with a BusLogic BT930 controller and a Number Nine

Imagine 128 Series 2 graphics accelerator card with 4MB of VRAM. The Plextor 8X CD-ROM drive helped it post the best CD-ROM WinMark 96 score of the roundup, an above-average result on our CD-ROM Sequential 16K Read tests, and a great score on our CD-ROM CPU Utilization tests. Other test scores were average.

Micron's tool-free mini-tower case holds an Intel motherboard with Intel's Natoma chip set and EDO DRAM. Additional components of the tested unit included a 17-inch Micron monitor (manufactured by ADI), a Creative Labs 16-bit wavetable audio card with Advent 270 speakers, and Microsoft Office Professional 95 with Bookshelf.

Micron offers a three-year-parts, one-year-labor warranty, with on-site service for the first year. This is augmented by five-year parts-and-labor coverage on the CPU

and memory. Micron offers 24-hour parts or system replacement and 24-hour, 7-day technical support. A variety of special service and support plans are available in conjunction with the company's third-party service provider. Micron will provide coupons for free upgrades to customers who buy systems within 30 days prior to Windows NT 4.0's release.—BB

Millennia Plus Pro200. Direct price: \$4,348. Micron Electronics Inc., Nampa, ID; 800-388-6334, 208-893-3434; fax, 208-893-3424; www.mei.micron.com. Circle 467 on reader service card.

SERVICE & RELIABILITY

Micron Electronics Inc.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Average

Mitsuba Corp.

Premier-Pro 200

The Mitsuba Premier-Pro 200 (\$3,799 street) combines an attractive price with competitive performance, especially on our Adobe Photoshop tests. Systems in this line are mostly targeted at value-added resellers, which add custom software to the units and resell them for use with high-end Windows NT graphics and engineering applications. The vendor does not sell directly to end users.

The Mitsuba distinguished itself with above-average scores on both Adobe Photoshop application tests—the Gaussian Blur and the disk-intensive Lighting Effects—thanks to a very fast Quantum Atlas II 2GB 7,200-rpm Ultra SCSI hard disk attached to an Adaptec 2940U controller. Other test scores were average, although the Mitsuba's Winstone 32 score was at the top of the average range.

The Mitsuba's tool-free midsize tower case holds the company's own motherboard with Intel's Natoma chip set. Other components include an STB Systems Lightspeed 128 graphics accelerator card with 2MB of MDRAM, a 17-inch Hyundai monitor, a Samsung 8X CD-ROM drive, a Creative Labs 32-bit wavetable audio card, and JUSTer SP-980 speakers.

Mitsuba does not have special corporate support lines for its Pentium Pro systems, but all machines are covered by the company's two-year warranty; on-site service is available for both years. The company of-

fers 24-hour, 7-day technical support.—*BB*
Premier-Pro 200. Street price: \$3,799. Mitsuba Corp., La Verne, CA; 800-648-7822, 909-392-2000; fax, 909-392-2021; www.mitsuba.com. *Circle 468 on reader service card.*

Multiwave Technology Inc.

Pro Power

Multiwave Technology's Pro Power (\$3,395) is designed for engineering and CAD applications. The system proved to be a mostly average performer.

Based on an Intel motherboard with Intel's Natoma chip set and EDO DRAM, the Pro Power comes in a mid-size tower case. The tested unit also came with a Matrox MGA Millennium graphics accelerator card with 2MB of WRAM, an Acer 761E 17-inch monitor, and a Maxtech/Acer 33.6/14.4-Kbps fax modem. An Ensoniq 16-bit audio card with wavetable synthesis was paired with JUSTer SP-980 speakers. Microsoft's Home CD bundle was also included; at no extra charge, this bundle can be replaced with Corel PerfectOffice.

Equipped with a 2GB 5,400-rpm Seagate hard disk, the Pro Power posted an average score on our Winstone 32 tests. Its Sony 8X CD-ROM drive, however, helped yield below-average scores on the CD-ROM WinMark 96 and CD-ROM Sequential 16K Read tests. Its CD-ROM CPU Utilization result, though, was very good. The system also managed slightly better-than-average performance on the

Adobe Photoshop Lighting Effects test.

Multiwave's warranty includes one-year-parts and lifetime-labor coverage, with on-site service for the first year. Plans for Windows NT 4.0 upgrades were not finalized at press time, but the company's intention is to provide free upgrades for those who purchase systems within 30 days of Windows NT 4.0's release. Technical support is available six days a week.—*BB*

Pro Power. Direct price: \$3,395. Multiwave Technology Inc., City of Industry, CA; 800-234-3358, 818-333-8558; fax, 818-333-4609; www.mwave.com. *Circle 469 on reader service card.*

NEC Technologies Inc.

PowerMate Pro 2200

NEC Technologies' DMI-enabled PowerMate Pro 2200 (\$3,471 street), one of our Editors' Choice winners, has the features, performance, and comprehensive support programs to make it a great choice for corporate use. The unit is a mainstream corporate system targeted for use in financial, engineering, and software development departments. NEC includes numerous hardware and software features, such as network and system management tools, to reduce the cost of ownership and maximize system performance and security. NEC recently merged with Packard Bell to form Packard Bell-NEC. NEC will continue to design and oversee the manufacturing of all of its PowerMate commercial desktop systems.

The PowerMate Pro system's tool-free mini-tower case holds an Intel motherboard with the Natoma chip set. To this NEC adds an IBM 2GB 5,400-rpm EIDE

SERVICE & RELIABILITY	
NEC Technologies Inc.	
Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Better than average

hard disk, a Matrox Millennium graphics card with 4MB of WRAM, and an NEC 8X MultiSpin 8V CD-ROM drive. The NEC MultiSync M700 monitor with integrated speakers is DCC-1 and DCC-2 compliant.

On most of our tests, the unit kept



Micro Express, Mitsuba, Micron Electronics.

Premier Power Platform

PREMIO® FX Pro200



Premier PREMIO® stands for dependability. Made by CompuTrend, an Inc. 500 company, all Premio motherboards and monitors are ISO-9000 certified. And YES, all Premio computers are NetWare® certified in our Novell® Labs approved test center. Premio computers carry a 3-year warranty, with optional on-site service.

Power Optimized for full 32-bit environments, the Premio FX Pro200 Pentium® Pro processor-based computer is your best choice for Windows® NT. With Burst EDO, Concurrent PCI, Bus Master IDE, and ECC, Premio delivers the power and reliability needed for your critical applications.

Platforms The Premio FX Pro is tested compatible with NetWare 4.x, Windows NT, Solaris®, and SCO® Unix, and is DMI-enabled. We cross test and integrate components from Adaptec®, 3Com®, Number Nine® and others. Custom, local assembly ensures solutions tailored to your needs are delivered quickly.

*"CompuTrend Systems' Premio - offers top components." "Moreover, it integrates them well, with strong performance as the result."
PC Magazine Feb. 20, 1996*

For the Premio partner nearest you, or more information on Premio Power Platforms, please contact us immediately:

Phone: 800-677-6477
Web: <http://www.premiopc.com>
E-mail: mktg@premiopc.com



GSA#: GS-35F-3066D CMAS: 3-95-70-0145A
CIRCLE 348 ON READER SERVICE CARD



MMX and AGP: Bridging the Video Gap

By Richard Fisco

While PC video has come a long way, it still has far to go to beat Sony, Sega, and Nintendo and become the platform of choice for games, 3-D, motion video, and virtual reality. To bridge this gap, Intel has developed two new technologies: MMX and AGP.

MMX is a multimedia extension to x86 code that will accelerate multimedia and communications applications. AGP (accelerated graphics port) is firmware that Intel will implement in memory controller chip sets to speed up 3-D graphics applications. Both technologies should appear soon, and by the end of 1997, Intel plans to sell almost exclusively MMX/AGP-enabled CPU subsystems.

MMX

MMX boosts the performance of applications such as motion video, audio synthesis, combined graphics and video, and 2- and 3-D graphics. It uses Single Instruction, Multiple Data (SIMD), which allows the parallel processing of many data pieces with one instruction. Using 64-bit MMX registers, an MMX instruction can operate simultaneously on 8 bytes, four 16-bit words, or two 32-bit pairs of words.

Applications that perform calculations on integer data repetitively and sequentially will benefit, and MMX provides 57 new x86 instructions and 8 new registers. But this poses a new problem for software developers: When generating MMX code, they must keep in mind that the 8 MMX registers are aliased upon the floating-point registers. This is true for both the P55C (an MMX-capable Pentium chip due in late 1996) and Pentium Pro-family processors. Intel plans to implement MMX throughout its product line between late 1996 and the end of 1997. The P55C will be first, followed by Klamath, a Pentium Pro with off-chip L2 cache due in mid-1997.

AMD (armed with a cross-licensing

agreement with Intel) plans to incorporate MMX into its K6, due out in early 1997. Cyrix will use compatible MMX technology in its next-generation M2 chip, due in the first half of 1997.

MMX AND THE P6

The Pentium Pro breaks x86 code into μ -ops (micro-ops.) Its pipeline consists of an in-order-issue front end, an out-of-order core, and an in-order retirement unit. The P6 treats MMX instructions as simple instructions with direct μ -op translations, resulting in better multimedia performance. The three pipeline units can work very efficiently in parallel, delivering higher through-

*All new Pentium Pro
CPUs will support
MMX and AGP to
boost video, audio, and
2- and 3-D graphics
performance.*

put with few pipeline stalls.

While we have no test results yet, Intel claims that the P55C's multimedia performance is 50 percent to 100 percent higher than that of a Pentium PC without MMX, when you use the P55C with optimized drivers and applications. With Pentium Pro's three-way superscalar and superpipelined architecture, expect to see the first MMX-enabled Pentium Pro PCs also gain a big performance boost from MMX code.

Most applications will take advantage of the new instructions by calling MMX-enabled drivers or by including new library routines. Applications without APIs written for them specifically (such as speech recognition and image editing) will have to include direct MMX instructions.

WHITHER NSP?

Remember Intel's NSP (native signal processing) initiative? If you think MMX sounds a lot like it, you're not too far off. Intel's idea for NSP was to off-load multimedia functions, such as sound and video clips, from DSPs (digital signal processors) to the host CPU. NSP lacked vendor support, especially from Microsoft, and never took off. Although the two initiatives are not the same, MMX helps achieve NSP's main goal: to improve multimedia performance without a DSP.

AGP

Intel announced its new high-speed chip set interface, AGP, early this year. It will be limited to the Pentium Pro to advance acceptance of the CPU. Other CPU and chip set vendors may develop compatible technology for Pentium-class PCs.

AGP is not a bus: It's a point-to-point connection that allows 3-D graphics data to bypass the PCI bus, which is a bottleneck for system designers. It uses the 66-MHz PCI Revision 2.1 specification as a baseline.

AGP allows 3-D texture data out of the cramped frame buffer (graphics controller memory) and into system memory, freeing up frame buffer memory and bandwidth for other functions. AGP directly links the fixed-function graphics processor, the frame buffer, the system chip set, and system memory. The design lets graphics processors access system memory at the speed of the system bus (usually 60 or 66 MHz, depending on CPU speed). Intel positions AGP as an aid to creating video and sophisticated 3-D graphics, but it may also boost 2-D performance.

Interestingly, AGP signals a partial move to the UMA (Unified Memory Architecture) approach of housing graphics data in system RAM. While this can have cost benefits, it can also mar performance for certain tasks that require both high memory bandwidth and high graphics bandwidth, because

the memory subsystem can't service multiple requests concurrently. It is possible that Intel has considered this problem and has devised a clever memory partitioning scheme.

In May Intel said it will incorporate AGP into P6 chip sets as early as 1997. Intel is pushing AGP aggressively and has already signed on Microsoft, ATI, Cirrus Logic, IBM, Trident, and S3. The latest AGP specification is on the Internet at www.teleport.com/~agfxport/.

TIME-SAVERS

The AGP uses a 32-bit data bus and a 66-MHz clock with a double-clocking technique. This technique lets AGP transfer twice as much data in a clock period, achieving a 133-MHz operational rate that translates into a 533-megabyte-per-second burst data transfer rate. The interface transfers data on both clock edges, thereby doubling the normal single-edge throughput.

Pipelining is a protocol enhancement provided by AGP that targets only main memory. As part of the AGP spec, texture data shifts from the frame buffer to main memory. This reduces the size and cost of frame buffer memory, but it requires extra space in main memory. While this seems like an equal trade-off, it can reduce system costs: Frame buffer memory may use expensive VRAM, SDRAM, and WRAM, while main memory uses less expensive DRAM. Further, pipelining allows the graphics chip set to initiate multiple transaction requests without waiting for data from previous requests.

Demultiplexing increases the speed of random memory accesses by using a sideband address (SBA) bus. The SBA demultiplexes the addresses of AGP transactions from the data. The SBA transmits only AGP access requests and therefore transmits only from master to target.

pace with the competition well, posting a score on our Winstone 32 tests that was at the high end of the average range. The unit also had average scores on the AutoCAD and C++ tests.

The PowerMate Pro supports DMI, and a MIF browser is available (although one was not sent for this roundup). Also included were McAfee's VirusScan for NT, Intel's LanDesk and HealthMeter, CyberMedia's First Aid 95, and MagicEye security technology. MagicEye is a combination of hardware and software that detects and reports when the system is opened; it also monitors system temperature, voltages, and fan speeds. The unit also features an IrDA-compliant, 115.2-Kbps infrared interface, which you can put to work with the included copy of Puma's TranXit.

NEC covers this line with a three-year warranty; on-site service is free for the first year. On-site coverage for two more years costs \$99. Augmenting its round-the-clock technical support, NEC has dedicated toll-free support lines for corporate customers, who are routed immediately to PowerMate technical-support specialists. Other service and support programs for corporate customers are available.—BB

PowerMate Pro 2200. Street price: \$3,471. NEC Technologies Inc., Boxborough, MA; 800-632-4636, 508-264-8000; fax, 800-366-0476; www.nec.com. Circle 470 on reader service card.

Polywell Computers Inc.

Poly P6-200N

Polywell Computers' Poly P6-200N (\$4,250) is literally a huge PC, intended for power users who need plenty of expansion capacity. And with eight front-accessible drive bays, it delivers. Many of the company's Pentium Pro systems are used in technology development and engineering departments that need high-powered platforms with a variety of storage alternatives.

At 22 inches tall, the Poly's case is bigger than many full-size tower cases. It has eight front-accessible drive bays and can support 15 SCSI devices (5 externally). The unit's Super Micro motherboard is SMP-compliant, with a socket for a second CPU. This board also features Intel's 440FX chip set and EDO DRAM. Other components include a 17-inch Sampo monitor, a 16-bit Sound Blaster audio card, and Yamaha YST-M5 speakers.

The system was an average performer on most of our tests, but it posted an above-average score on the CD-ROM WinMark 96 tests thanks to its Toshiba 8X CD-ROM drive. But its CD-ROM CPU Utilization score was unimpressive, as was its score on our C Compiler application test. Otherwise, the unit's Seagate 2GB 7,200-rpm Fast/Wide SCSI-2 hard disk with an Adaptec 2940W controller and the Diamond Stealth64 graphics accelerator card with



Polywell, Multiwave Technology, NEC Technologies.

2MB of VRAM helped secure admirable scores.

Polywell offers a two-year-parts, five-year-labor warranty. On-site service is available for \$75 for one year, \$100 for two years, and \$150 for three years. Standard technical support is available six days a week. The company also has a specially trained technical team that provides VIP service for Pentium Pro customers and can work with corporate customers to tailor further support programs.—BB

Poly P6-200N. Direct price: \$4,250. Polywell Computers Inc., South San Francisco, CA; 800-999-1278, 415-583-7222; fax, 415-583-1974; www.polywell.com. Circle 471 on reader service card.

ProGen Systems

Nova II 200MHz

ProGen Systems' Nova II 200MHz (\$3,449 direct) is a good performer and is offered at a moderate price considering its components, making it a fine buy for mainstream customers. The company markets the unit to high-end professional users.

ProGen has been in the computer business for 12 years and initially provided hardware to computer consulting firms and system integrators. Currently, the company's main customer base consists of MIS and engineering buyers.

Based on an Intel motherboard with Intel's 440FX core-logic chip set, the tested Nova II used a midtower case. The system also came with a Matrox MGA Millennium 3D graphics accelerator card with 4MB of WRAM and a MAG InnoVision DX1795 monitor. Microsoft Office Professional, a Creative Labs SB-16 PnP wavetable audio card (a 32-bit Creative Labs AWE32 card with wavetable and FM synthesis will be standard by the time you read this), and MidiLand MLi-D2 speakers round out the hardware package.

A Pinnacle Micro 10X CD-ROM drive—the only one in this roundup—helped the Nova II post the highest CD-ROM Sequential 16K Read score in this roundup. The system also performed above average on our AutoCAD test but below average on our Adobe Photoshop Gaussian Blur test. Its Winstone 32 score



was average. These results could well be attributed to its 2.4GB Western Digital Caviar 5,200-rpm EIDE hard disk; numerous other systems here used disks with 7,200-rpm spin speeds. The unit also had a poor CD-ROM CPU Utilization result, which may have contributed to its below-average CD-ROM WinMark 96 score.

The Nova II has a three-year warranty, with one year of on-site service included. On-site coverage for two more years costs \$138. And 24-hour replacement is available, at the discretion of the technical-support staff. Technical support is available on weekdays.—BB

Nova II 200MHz. Direct price: \$3,449. ProGen Systems, Tustin, CA; 800-848-1353, 714-566-9200; fax, 714-566-9267; www.progen.com. Circle 472 on reader service card.

Quantex Microsystems

QP6/200 WS-2

The Quantex QP6/200 WS-2, from Quantex Microsystems, is a reasonable choice for mainstream business use based on its average performance on our benchmark and application tests and on its highly competitive price of \$3,499. Quantex targets its Pentium Pro systems at small-office/home-office users and more generally at anyone intending to use 32-bit software and Windows NT.

The tested system, housed in a midtow-

er case, used an Intel motherboard with Intel's Orion chip set and EDO DRAM, although it doesn't support EDO's extra features. The company also supplied us with a MAG InnoVision DX17T monitor, with a Toshiba 6.7X XM-3701B CD-ROM drive, with an Ensoniq Vivo wavetable sound card, with a set of Altec Lansing ECS31 speakers that include a subwoofer, and with a Microsoft Natural keyboard.

The system garnered average scores on most of our tests. These results were partly due to its Seagate 2GB 5,400-rpm Fast/Wide SCSI-2 hard disk with an Adaptec 2940W Fast/Wide controller and its Number Nine Imagine 128 graphics accelerator board with 2MB of VRAM.

The unit has a three-year warranty, with on-site service included for the first year. Two extra years of on-site coverage via VanStar costs \$199. Technical support is offered during extended business hours on weekdays and during standard business hours on Saturday.

Quantex customers who purchase systems with Windows NT 3.51 within 30 days prior to Windows NT 4.0's release will receive a free upgrade.—BB

QP6/200 WS-2. Direct price: \$3,499. Quantex Microsystems, Somerset, NJ; 800-760-9001, 908-563-4166; fax, 908-563-0407; www.quantex.com. Circle 473 on reader service card.

Reason Technology Inc.

Square 6 NA/VA

With a direct price of \$2,975, the Reason Square 6 NA/VA succeeds in combining low cost and mostly average performance, which should please the value-oriented high-end users Reason Technology targets with this unit. Reason also markets a Savvy line of PCs, which are value-oriented machines sold mostly

through resellers.

The 6X TEAC CD-26E CD-ROM drive had difficulty competing with the faster drives in this roundup on our CD-ROM WinMark 96 and CD-ROM Sequential 16K Read tests (both scores were below average). The CD-ROM CPU Utilization score, however, was much better than average. Using an Intel Venus motherboard with the Natoma chip set and a 2.4GB Quantum EIDE 4,500-rpm hard disk, the unit garnered average scores on all of our other tests.

The mini-tower system is easy to get into because of its tool-free chassis design. The unit's Ensoniq sound card with wavetable synthesis and Yamaha speakers help provide clear sound, while the Samsung 17GLsi monitor and Matrox MGA Millennium card with 4MB of WRAM offer strong video quality.

Reason Technology prices on-site service at \$49 for the first year and covers labor for six years and parts from one to three years, depending on the part. Technical support is available six days a week. The company is awaiting Microsoft's announcement to finalize its Windows NT 4.0 upgrade pricing policy.—*Frank J. Evans*

Square 6 NA/VA. Direct price: \$2,975. Reason Technology Inc., Minneapolis, MN; 800-800-4860, 612-780-4792; fax, 612-780-4797; www.reasontech.com. Circle 474 on reader service card.

Robotech Inc.

Cobra XLP Pro 200

The Cobra XLP Pro 200 (\$3,799 street) is aimed at users seeking a high-end system at a reasonable price. To provide additional value, Robotech includes many extras, such as an Ethernet card, a DSVD modem, an APC Network Surge arrest strip with telephone protection, conveniently packed loose-leaf binders with system information, and bundled software. All such features are designed to get your PC up and running quickly and easily.

The Cobra posted an above-average CD-ROM Sequential 16K Read score, thanks to its 8X Acer CD-ROM drive, and average scores on our CPUmark₃₂ and C Compiler tests. The older Orion chip set, standard DRAM, Number Nine Motion 771 graphics card, and 2GB Seagate Fast ATA-2 hard disk contributed to below-average results on our Winstone 32 tests. Most other test scores were also below average.

The tested unit came with a 17-inch Princeton Ultra 17+ monitor, a 3Com EtherLink III PCI card, a U.S. Robotics Sportster VI 28.8/14.4-Kbps DSVD modem, a Creative Labs Sound Blaster 16 CSP card, Yamaha YST-M10 speakers, and a Labtec C2 headset. Robotech also bundled Microsoft Office Pro and Intel's Proshare teleconferencing software with the system.

The CPU and the memory have lifetime warranties; a three-year warranty on parts is provided for all other components. Labor and on-site service are covered for one year; three additional years of on-site service costs \$199. Technical support is available during business hours. Robotech plans to follow Microsoft's policy in pricing upgrades to Windows NT 4.0.—*FJE*
Cobra XLP Pro 200. Street price: \$3,799. Robotech Inc., Midvale, UT; 800-255-2215, 801-565-0645; fax, 801-565-0680; www.robotechusa.com. Circle 475 on reader service card.

SAG Electronics

STA Pro 200 Desktop



Aimed at business power users, the Editors' Choice-winning STA Pro 200 Desktop delivers in terms of performance, and SAG Electronics sweetens the deal further with a bargain price of \$2,999.

The STA Pro 200 Desktop was an impressive performer on our benchmark tests. Components such as the AMI Merlin motherboard using Intel's Natoma chip set (which supports EDO DRAM and error-correction parity memory) helped the unit post some of this roundup's highest scores on our Adobe Photoshop tests. Its 2GB Seagate Fast/Wide SCSI-2 hard disk, paired with an Adaptec 2940UW ultrawide controller, gave the unit another performance edge, earning it the second-highest Winstone 32 score. Most other test scores were average.

The Matrox MGA Millennium 2MB graphics card and 17-inch MAG InnoVision DX17T monitor provide users with clear graphics and high-quality video. A Creative Labs Sound Blaster 32 IDE PnP card with both wavetable and FM synthesis support offers full sound through the Sony SRS-PC30 speakers, which can be attached to the monitor. An 8X Toshiba XM-5620B CD-ROM drive completes the hardware package. The STA Pro 200 Desktop is USB-compatible.

SAG Electronics provides technical support during business hours; on-site service with 24-hour replacement is available for an extra \$70 a year. The STA Pro 200 Desktop is covered by a two-year parts-



SAG Electronics, Reason Technology, Robotech.



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PROCESSOR

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CIRCLE 122 ON READER SERVICE CARD

and-labor warranty, but there is an additional five-year limited warranty on certain components. The company is waiting for Microsoft's announcement before finalizing its Windows NT 4.0 upgrade pricing policy.—FJE

STA Pro 200 Desktop. Direct price: \$2,999. SAG Electronics, North Andover, MA; 800-989-3475; fax, 508-689-0180; www.sagelec.com. *Circle 476 on reader service card.*

Sys Technology Inc.

Performance Pro 200

The Sys Performance Pro 200 (\$4,176 direct) is aimed at the corporate power user and was one of the few systems in this roundup to include an Ethernet network card. The unit earned mostly average marks on our tests.

The tested system came with two Quantum Fireball 1280 hard disks, which secured an average Winstone 32 score. The use of a Toshiba XM-5602B 8X CD-ROM drive resulted in one of the least impressive scores on our CD-ROM Sequential 16K Read test, and its CD-ROM CPU Utilization result was among the worst in the roundup. Other benchmark test scores were average. Performance should increase as Sys Technology phases out the current ASUSTek motherboard (based on the older Intel Orion chip set, which does not support EDO DRAM) in favor of motherboards using the newer Intel Natoma chip set.

Since the system uses two hard disks, the mini-tower system is slightly cramped. Card-swapping and service, however, are fairly easy, since the motherboard can slide out of the case. Our tested configuration included a Matrox MGA Millennium graphics card with 2MB of WRAM, a 17-inch MAG InnoVision DX1795 monitor, and a Sound Blaster 16 Vibra IDE PnP sound card, as well as a 3Com 10/100 Fast EtherLink PCI card and a Cardinal 28.8/14.4-Kbps V.34 modem.

Sys provides 24-hour, 7-day toll-free technical sup-

port. Its unit also comes with a one-year warranty on parts and labor that includes on-site service. This warranty can be extended by one, two, or three years for \$139, \$199, or \$249, respectively. The company will also honor the manufacturer's guarantee on parts that have warranties lasting more than a year. While Sys plans to offer Windows NT 4.0 when it becomes available, the company has no plans to provide free or reduced-cost upgrades.—FJE

Performance Pro 200. Direct price: \$4,176. Sys Technology Inc., Cypress, CA; 800-613-9963, 714-821-3900; fax, 714-821-9592; www.systechtechnology.com. *Circle 477 on reader service card.*

Tagram System Corp.

Tagram Thunderbolt Corporate T6

The Tagram Thunderbolt Corporate T6 (\$3,445 direct) has top-notch components and garnered mostly competitive scores on our tests. The system is targeted toward midsize corporations looking for high-end Windows NT workstations.

The T6's disk and CD-ROM subsystem helped it achieve some of its best scores. The combination of an Adaptec 2940UW controller card, a 2GB Quantum Atlas Fast/Wide SCSI-2 hard disk, and a Toshiba XM-3701B 6.7X CD-ROM drive secured above-average scores on our Adobe Photoshop and CD-ROM WinMark 96 tests. Its CD-ROM CPU Utilization score was worse than average. Using

an older Intel Performance AU motherboard and Orion chip set (which does not support EDO DRAM), the unit posted average Winstone 32 results. Other test scores were average, except for a CD-ROM CPU Utilization result that was below average for this roundup.

The tested system also came with a Matrox MGA Millennium graphics accelerator card with 2MB of WRAM, and a clear, 17-inch MAG InnoVision DX1795 monitor. Sound was provided by an Ensoniq SoundScape audio card capable of both wavetable and FM synthesis. The system's included Quickshot Soundforce 600 speakers were adequate.

Tagram is awaiting Microsoft's announcement to determine its Windows NT 4.0 upgrade pricing policy. A one-year warranty covers parts and labor, and technical support is provided on weekdays and Saturdays. An additional \$50 buys you one year of on-site service.—FJE

Tagram Thunderbolt Corporate T6. Direct price: \$3,445. Tagram System Corp., Costa Mesa, CA; 800-824-7267, 714-979-8900; fax, 714-979-8970; www.tagram.com. *Circle 478 on reader service card.*

Total Peripherals Inc.

Total Peripherals Lightning

The Total Peripherals Lightning (\$3,159 direct) is an average performer aimed at corporate engineers and designers who run heavy graphics, desktop publishing, and 3-D animation

applications. Total Peripherals has been in the computer business for 12 years, marketing systems mostly to government, corporate, and educational facilities. The company also licenses its machines to other vendors and sells systems through value-added resellers.

Using a 2GB Fast ATA-2 Seagate hard disk and a 2MB Diamond Stealth64 graphics card, the mini-tower unit managed average scores across most of our tests. The unit's score on our C Compiler test was



Tagram System, Sys Technology

below this roundup's average. The Lightning's 8X Acer CD-ROM drive secured a good score on our CD-ROM Sequential 16K Read test and one of the highest (worst) scores on our CPU Utilization measure. Its CD-ROM WinMark 96 result was average.

The Lightning uses an ASUSTek motherboard with Intel's older Orion chip set, which does not support EDO DRAM. The tested system also came with an Acer 7176ie 17-inch monitor, a Creative Labs Sound Blaster 16 IDE PnP sound card, and Suntek YS-320 speakers.

Total Peripherals offers a two-year parts-and-labor warranty, which includes on-site service and 24-hour, 7-day toll-free support for the first year.—*FJE*

Total Peripherals Lightning. Direct price: \$3,159. Total Peripherals Inc., Northboro, MA; 800-422-1139, 508-393-1777; fax, 508-393-9211; www.totalpc.com. Circle 479 on reader service card.

Unisys PC Division

Aquanta DM/6

Unisys PC Division's Aquanta DM/6 offers such features as DMI compliance and an IrDA-compliant infrared port. But at \$5,509 on the street, it's also the most expensive machine in this roundup. Marketed as a corporate workstation and a graphics modeling tool, this mini-tower system occupies the high end of the Unisys Aquanta DM line. As of this summer, this desktop line also boasts Pentium PCs with clock speeds of up to 200 MHz.

The Aquanta's tool-free chassis opens easily to reveal an FIC-built Unisys CMT60061 motherboard that can be detached by removing only three screws. The Energy Star-compliant system uses the Orion chip set and thus fast-page-mode DRAM.

Such features partially ac-



Unisys, Total Peripherals, Unitek Technology.

counted for below-average results on our Adobe Photoshop Gaussian Blur and Lighting Effects tests. A capable 2GB Seagate hard disk with a 5,400-rpm rotational speed and a proficient graphics card—the Number Nine Imagine 128 with 4MB of VRAM—secured average scores in most other areas. The only exceptions were below-average CD-ROM WinMark 96 and CD-ROM Sequential 16K Read results, due to a 4X Toshiba SCSI-2 drive (most units in this roundup used at least 6X drives).

Creative Labs supplies the system's speakers and 16-bit ISA sound card, while the EUG174-COL monitor carries the Unisys name. Although Unisys also offers DMI compliance, it does not bundle a MIF browser.

To round out the package, the company includes a three-year warranty, which covers a year of on-site service. For a graduated fee, users can augment this on-site service with a guaranteed minimum response time; the greater the fee, the faster the response. Unisys's toll-free technical support is available weekdays during extended business hours.

Beginning July 15, customers purchasing Windows NT 3.51-equipped systems will receive a coupon for a free upgrade to Version 4.0.—*CM*

Aquanta DM/6. Street price: \$5,509. Unisys PC Division, San Jose, CA; 888-278-2682, 408-434-2848; fax, 408-434-4844; www.pc.unisys.com. Circle 480 on reader service card.

SERVICE & RELIABILITY

Unisys PC Division	
Reliability	Worse than average
Repair	Average
Technical support	Average
Percent needing repair	Average

Unitek Technology Inc.

UT-PP200 Commando

Unitek Technology's UT-PP200 Commando, which offers mostly competitive performance, is a bargain at \$2,995 on the street. This Energy Star-compliant machine is built around a core of modest components, but a healthy software bundle and a Fast Ethernet card raise its stock considerably. In addition to the Commando—a system aimed at the high-end engineering set as well as demanding government purchasers—Unitek sells Pentium systems to similar markets.

The Commando chassis contains an Intel Aurora motherboard with Intel's Orion chip set, which nullifies the advantages of the system's EDO DRAM. This configuration is accompanied by a 1.6GB Western Digital EIDE hard disk with a rotational speed of 5,200 rpm.

Using a Matrox MGA Millennium graphics card with 4MB of WRAM, the system posted average scores on most of our tests. The exceptions were the unit's scores on the AutoCAD tests and both Adobe Photoshop tests, which were below average. Because of its Sanyo 6X CD-ROM drive, the Commando's CD-ROM test scores were also below average.

A ViewSonic 17-inch monitor with built-in speakers, DMI compliance, a 16-bit Creative Labs sound card with FM synthesis, a 115.2-Kbps IrDA port, and a 3Com 3C595-TX PCI 10/100 Ethernet card enhance the appeal of the unit. It also came with bundled copies of Microsoft Office Pro and Intel LANdesk.

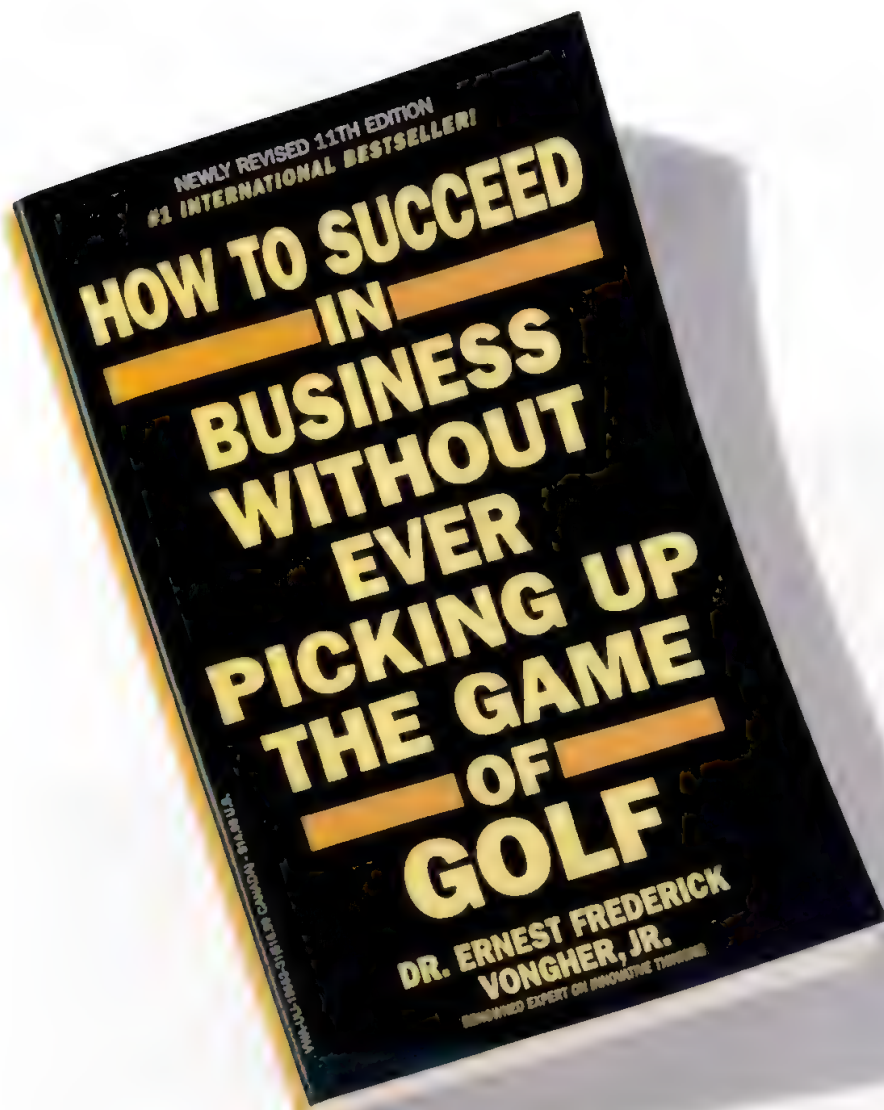
For \$75, you can add on-site service to Unitek's one-year warranty. Technical support is provided six days a week.—*CM*

UT-PP200 Commando. Street price: \$2,995. Unitek Technology Inc., Ontario, CA; 800-944-5650, 909-930-5700; fax, 909-930-5710. Circle 481 on reader service card.

Vektron

Optima Pro Station

For an appealing direct price of \$2,995, the Vektron Optima Pro Station provides several impressive core components and a great warranty, but its Winstone 32 score was the lowest in this roundup. Vektron gears the machine toward high-end corporate users, while aim-



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ing its Power PC and Home PC lines at the Pentium-based markets.

Vektron has recently switched to an Intel Venus motherboard, but this change did not occur in time for our roundup. We received a system with a SuperMicro motherboard in a tower case, which offers a lockable cover to protect all drive bays. The Optima Station also has such components as Intel's Natoma chip set, EDO DRAM, a Toshiba 8X CD-ROM drive, and a 2.4GB 5,200-rpm Western Digital Caviar hard disk with an EIDE interface.

The system's extremely poor Winstone 32 score owes itself in part to the hard disk, but the true culprit was the Diamond Stealth 3-D graphics card with S3's Virge chip set. This graphics board is new, and we suspect that its drivers have not yet been optimized for Windows NT. Other test scores were average.

The system also has a 17-inch MAG monitor and a 16-bit Creative Labs Sound Blaster 32 sound card with wavetable and waveguide synthesis. Yamaha M10 speakers with subwoofer, Microsoft Office Pro, and a 28.8/14.4-Kbps fax modem with voice mail, full-duplex speakerphone, and caller ID support complete the package.

Vektron—which plans to provide free upgrades to Windows NT 4.0—offers a one-year-parts, lifetime-labor warranty, with four years of on-site service. Technical support is available six days a week.—*CM*
Optima Pro Station. Direct price: \$2,995. Vektron, Grand Prairie, TX; 800-659-5375, 214-606-0280; fax, 214-606-1475; www.vektron.com. *Circle 482 on reader service card.*

Xi Computer Corp.

Pro200 MTower DP/SP

Aimed at high-end corporate users, CAD professionals, and power graphics users, the \$4,549 Pro200 MTower DP/SP from Xi Computer Corp. offers competitive performance and an easy upgrade path to a second CPU. For less demanding users, Xi also ships a line of Pentium PCs.

The unit has a Tyan ATX-form-factor motherboard with Intel's Natoma chip set and EDO DRAM. This midtower system boasts two SCSI-2 ports, as well as a Wide SCSI-2 port.

A 2.2GB Fast/Wide SCSI-2 IBM hard disk (with a rotational speed of 7,200 rpm) and a Matrox MGA Millennium graphics card with 4MB of WRAM helped yield average scores for the unit on most of our tests. It posted below-average scores on our C Compiler test, however.

Each of the Pro200's other components is top of the line: a DDC1- and DDC2-compliant Viewsonic Optique V775 monitor, a 6.7X Toshiba XM-3701B CD-ROM drive, a Creative Labs AWE32 sound card with wavetable and waveguide synthesis, four speakers, and a subwoofer from Benwin. The system also features a USB port, a 115.2-Kbps IrDA-compliant infrared port, and a 28.8/14.4-Kbps fax modem with voice mail, full-duplex speakerphone, and caller ID support.

In addition to bundling copies of Microsoft Office Pro and Xi Surround Amplifier, Xi promises free upgrades to Microsoft Windows NT 4.0 and includes a

three-year warranty with on-site service for the first year. Toll-free technical support is available six days a week.—*CM*
Xi Pro200 MTower DP/SP. Direct price: \$4,549. Xi Computer Corp., San Clemente, CA; 800-432-0486, 714-498-0858; fax, 714-492-6571; www.xicomputer.com. *Circle 483 on reader service card.*

Zenon Technology Inc.

Optima Pro Station

For the middle-of-the-road direct price of \$3,499, the Zenon Optima Pro Station takes the high road in terms of performance. On many of our tests, this tall tower system earned above-average scores, including the highest Winstone 32 score in this roundup. Zenon aims this unit at the high-end corporate workstation set, as well as the 3-D graphics market. The company also sells Pentium systems through the Power Pro corporate line and a Super Media line for the home office.

The Optima Pro Station arrived well equipped, with a Matrox MGA Millennium graphics accelerator board with 2MB of WRAM, a 2GB Seagate Barracuda Fast/Wide SCSI-2 7,200-rpm hard disk, and a CMD hard disk controller with 16MB of cache. These components secured the unit's unmatched score on our Winstone 32 tests and its above-average scores on our Photoshop and AutoCAD tests.

A SuperMicro dual-CPU motherboard and Intel's Natoma chip set form the system's core. Outside the chassis, two USB ports and a SCSI port provide peripheral options. A MAG 17-inch monitor, a TEAC 6X CD-ROM drive, a 28.8/14.4-Kbps modem (a 33.6/14.4-Kbps modem will be standard by press time), a Pro Link 16-bit ISA sound card, and two MLI 818 speakers complete the hardware package. The unit also features a temperature-sensitive backup fan and alarm.

The Zenon unit has a one-year-parts and lifetime-labor warranty. On-site service costs \$160 for the first year and \$290 for the following three years. Technical support is available six days a week.—*CM*
Optima Pro Station. Direct price: \$3,499. Zenon Technology Inc., City of Industry, CA; 800-699-8119, 818-935-1828; fax, 818-935-1826; www.primenet.com/~zenon. *Circle 484 on reader service card.*

PC Tech

THE DEFINITIVE GUIDE TO PC TECHNOLOGIES & TOOLS

How the Common Gateway Interface Works

CGI lets your server retrieve data from Web browser forms.

By Ray Duncan



The increasing sophistication and flexibility of PC-based Web servers and their integration with databases have made traditional Common Gateway Interface (CGI) applications somewhat passé, and a flood of books and articles on the subject has made

CGI considerably less mysterious. Now the cutting edge of Web server technology has shifted from the Common Gateway Interface to Java and Virtual Reality Modeling Language (VRML).

Despite all of this, familiarity with CGI is still extremely useful. And if your company is using Unix-based machines as Web servers, some contact with CGI will probably be unavoidable.

THE COMMON GATEWAY INTERFACE

The Common Gateway Interface is a rather imposing name for what is, in essence, a very simple concept. It defines how information, collected from a user by means of a form in a Web browser, will be passed through the Web server to an executable program, and how the results will be passed back to be displayed to the user by the Web browser.

The general structure of the HyperText Markup Language (HTML) for a Web form looks something like this:

```
<HTML>
<HEAD>
<TITLE>Page Title Here</TITLE>
</HEAD>
<BODY>
<FORM>
... HTML code for
  various "controls"
  goes here ...
</FORM>
</BODY>
</HTML>
```

The text of the form and the HTML tags for the various controls on the form—text entry boxes, pop-up menus, radio buttons, check boxes, and Submit or Reset buttons—are placed between the `<FORM>` and `</FORM>` tags.

The `<FORM>` tag has two important attributes or modifiers: `METHOD` and `ACTION`. The `METHOD` attribute can take on one of two values, `GET` or `POST`, which specify how the information from the form will be presented to the program that will process it. The `ACTION` modifier is used to specify the Uniform Resource Locator (URL) of an executable program or script that will process the information.

Consider the following skeleton of an HTML form:

```
<HTML>
<HEAD>
```

```
<TITLE>Page Title Here</TITLE>
</HEAD>
<BODY>
<FORM METHOD="post"
ACTION="http://www.xyz.com/cgi-
bin/myprog.pl">
... HTML code for
  various controls
  goes here ...
<INPUT TYPE="submit" VALUE="Submit
Form">
</FORM>
</BODY>
</HTML>
```

In this case, when the user clicks the button that's labeled Submit Form, the Web browser will collect the information from the other controls between the `<FORM>` and `</FORM>` tags and send it to the Web server that delivered the form. The Web

CGI ENVIRONMENT VARIABLES

Variable name	Description
AUTH_TYPE	Authentication method used to validate the user.
CONTENT_LENGTH	Length of the data (in bytes or number of characters) passed to the CGI program via the standard input.
CONTENT_TYPE	MIME type of the data delivered to the CGI program; for example, TEXT/HTML.
DOCUMENT_ROOT	Home directory of the Web server.
GATEWAY_INTERFACE	Version of the Common Gateway Interface supported by the Web server.
HTTP_ACCEPT	MIME data types that the client machine can accept.
HTTP_FROM	E-mail address of the user making the request (if supplied by the Web browser).
HTTP_REFERER	URL of the HTML document containing the <code><FORM></code> tag that activated the CGI program.
HTTP_USER_AGENT	Name and version of the Web browser being used as the client.
PATH_INFO	Extra path information passed to the CGI program.
PATH_TRANSLATED	Translated version of the information in the <code>PATH_INFO</code> variable.
QUERY_STRING	Query information passed to the CGI program.
REMOTE_ADDR	IP address of the machine running the Web browser that originated the CGI request.
REMOTE_HOST	Host name of the machine running the Web browser that originated the CGI request.
REMOTE_IDENT	User making the request (rarely used; requires support of an identification daemon on the client machine).
REMOTE_USER	Authenticated user name.
REQUEST_METHOD	Method used for the CGI request (<code>GET</code> or <code>POST</code>).
SCRIPT_NAME	Location of the script being executed.
SERVER_NAME	Server host name or IP address.
SERVER_PORT	Port number used by the Web server.
SERVER_PROTOCOL	Name and version of the information protocol used in the CGI request.
SERVER_SOFTWARE	Name and version of the Web server software.

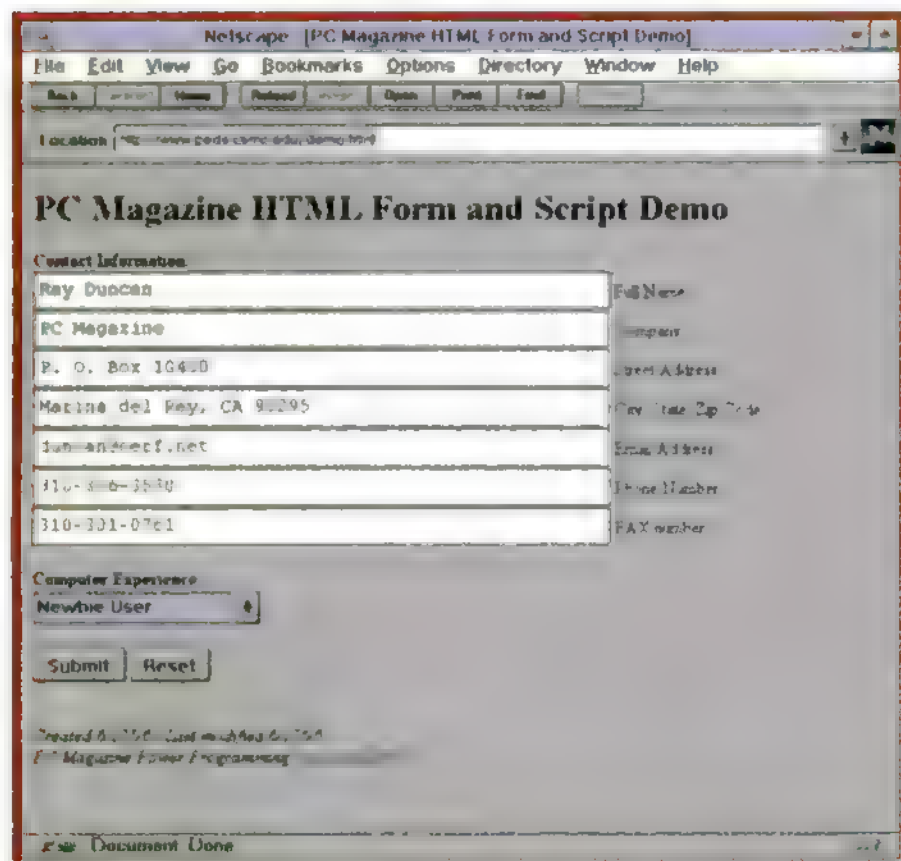


FIGURE 1: Here is how a simple HTML form appears in your World Wide Web browser.

server will in turn activate the program that's specified by the ACTION modifier—referred to as the *CGI program* or the *gateway program*—and pass it the form's data in the manner specified by the METHOD modifier.

It's important to note that the Web client, server, and CGI program can be located anywhere on the network—they might be on the same machine or on three different machines. Typically, however, the Web server and the CGI program reside on the same machine, for security reasons. In fact, on many Web servers, CGI programs can be executed only if they reside in a particular authorized directory (named by convention *cgi-bin*), so that the Webmaster does not have to worry about Internet hackers subverting the CGI interface to run random

programs anywhere on the server machine's hard disk.

HOW A CGI PROGRAM WORKS

The CGI program finds the form information that the Web server has passed to it in one of two places. If the CGI program is invoked by a `<FORM>` tag with the GET method, the form's information will be accessible in an environment variable named `QUERY_STRING`. If it is invoked with the POST method, the form's information will appear as a string on the standard input device, just as if the information had been typed in at the keyboard on the same machine or had been passed to the program, via input redirection from a pipe or file with the redirection operator `|` or `<` on the com-

mand line. Other useful information is also supplied to the CGI program by the Web server through a host of predefined environment variables (see the table "CGI Environment Variables").

By now you are no doubt wondering, "How are the contents of the form's controls formatted so that they can be delivered in a single string through the standard input device or an environment variable?" The answer, unfortunately, is, "Not very conveniently." Each control name and its value are paired, separated by an equal sign. Each pair of control names and values is in turn concatenated into a single string, separated by ampersands. Spaces, punctuation, and control characters are mapped to their hexadecimal equivalents, with the percent sign as the escape character.

For example, assume that a form has a text-box control named `username` that contains the string "Donald Knuth" and another text-box control named `occupation` that contains the string "programmer, writer." When the submit button of this form is clicked, the following string will be delivered to the CGI program via the standard input device or the `QUERY_STRING` environment variable:

```
username=Donald%20Knuth&occupation=
programmer%20writer
```

The CGI program is responsible for parsing this hodgepodge into the original control names and their values supplied by the user of the Web browser, translating escape-character combinations back into their original characters, processing the form's data, and returning the result of the CGI transaction to the user. It accomplishes the last simply by writing HTML text and tags to the standard output device. The output stream is then captured by the Web server and passed back to the Web client that submitted the form in the first place. In other words, the Web page seen by the user as the result of submission of the form doesn't necessarily exist anywhere as an HTML document. It can be generated on the fly by the CGI program.

WRITING CGI PROGRAMS

Since a CGI program gets its data from environment variables and the standard input device and sends the results of its processing to the standard output device, you can write a CGI program in any language, from Visual Basic to C++. For that matter, a CGI program is free to communicate with as many other programs as is necessary to do its work,

```
<HTML>
<HEAD>
<TITLE>PC Magazine HTML Form and Script Demo</TITLE>
</HEAD>
<BODY>
<H1>PC Magazine HTML Form and Script Demo</H1>
<FORM method="POST" action="http://www.peds.csmc.edu/
demo.pl">
<B>Contact Information:</B><BR>
<INPUT NAME="name" SIZE=50> Full Name<BR>
<INPUT NAME="company" SIZE=50> Company<BR>
<INPUT NAME="street" SIZE=50> Street Address<BR>
<INPUT NAME="city" SIZE=50> City, State, Zip Code<BR>
<INPUT NAME="email" SIZE=50> Email Address<BR>
<INPUT NAME="phone" SIZE=50> Phone Number<BR>
<INPUT NAME="fax" SIZE=50> FAX number<BR>
<P>
<B>Computer Experience</B><BR>
<SELECT NAME="experience">
```

```
<OPTION>Veteran Hacker
<OPTION>Novice Programmer
<OPTION>Power User
<OPTION>Newbie User
<OPTION>Other
</SELECT>
<P>
<input type="submit" value="Submit">
<input type="reset" value="Reset">
</FORM>
<P>
<HR>
<ADDRESS>
Created 6/17/96 / Last modified 6/17/96<BR>
PC Magazine Power Programming / <A HREF="mailto:
duncan@csmc.edu">duncan@cerf.net</A>
</ADDRESS>
</BODY>
</HTML>
```

FIGURE 2: This is the HTML code for the form shown in Figure 1.


```
#!/usr/bin/perl

require "scripts/cgi-lib.pl";

&print_HTTP_header;
&print_head;
&process_form;
&print_body;
&print_footer;
&print_tail;

#
# This subroutine emits the required HTTP header
# for the "results" page seen by the user
#
sub print_HTTP_header {

    print "HTTP/1.0 200 OK\n";
    print "Content-type: text/html\n";

}

#
# This subroutine emits the HEAD section including
# the page title, then opens the BODY section
# and emits a level-one heading.
#
sub print_head {

    print "\n";
    print "<HTML>\n";
    print "<HEAD>";
    print "<TITLE>";
    print "PC Magazine HTML Form and Script Demo Results";
    print "</TITLE>";
    print "</HEAD>";
    print "<BODY>";
    print "<H1> PC Magazine HTML Form and Script Demo
        Results</H1>";

}

#
# This subroutine formats the data entered by the
# user into the "$message" variable.
#
sub process_form {

    # First we call cgi-lib.pl routine to parse the form data
    # string into the component variable names and their
    # values &ReadParse();

    # Now we format some captions and the variable values
    # into a single long string for convenience. We could write
    # this result string to a file or email it, but for this
    # demonstration we will just display it back to the user.
    $message = <<END;

    Name:           $in{name}
    Company:        $in{company}
    Street:         $in{street}
    City, State, Zip: $in{city}
    Email:          $in{email}

    Phone:          $in{phone}
    Fax:            $in{fax}

    Computer Experience: $in{experience}

END

}

#
# This subroutine displays the formatted data
# from the data entry form for review by the user.
#
sub print_body {

    print <<END;

    Thank you for filling out our form. Here is a summary
    for your records of the information as we received it.
    You can click the PRINT button in your browser to
    generate a hard copy of this transaction.<P>
    <HR>
    <P>

    <PRE>
    $message
    </PRE>
    <P>

END

}

#
# This subroutine emits the page footer as seen by the user.
#
sub print_footer {

    print <<END;

    <P>
    <HR>
    <ADDRESS>
    Created 6-15-96 / Last modified 6-15-96<BR>
    PC Magazine Power Programming /
    <A HREF="mailto:duncan@cerf.net">duncan@cerf.net</A>
    </ADDRESS>

END

}

#
# This routine closes the <BODY> and <HTML> sections
# of the HTML output stream.
#
sub print_tail {

    print "</BODY>";
    print "</HTML>\n";

}

}
```

FIGURE 3: This PERL script processes the HTML form shown in Figure 1.

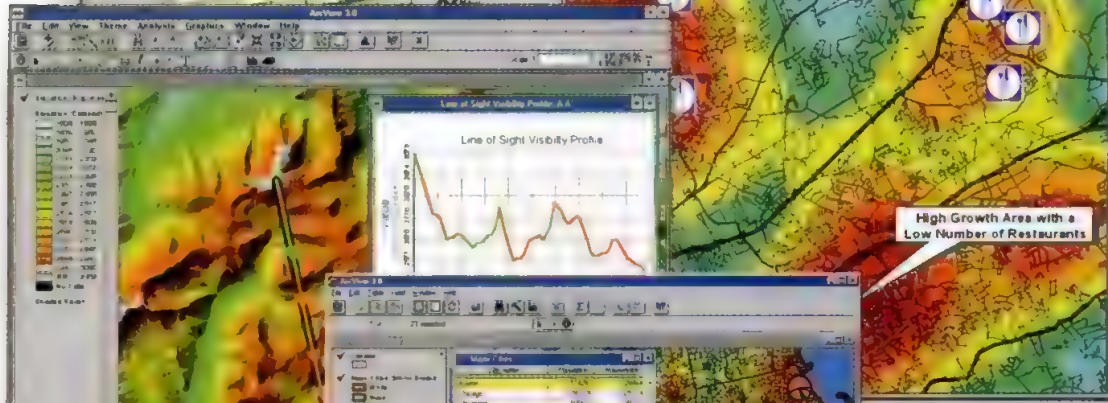
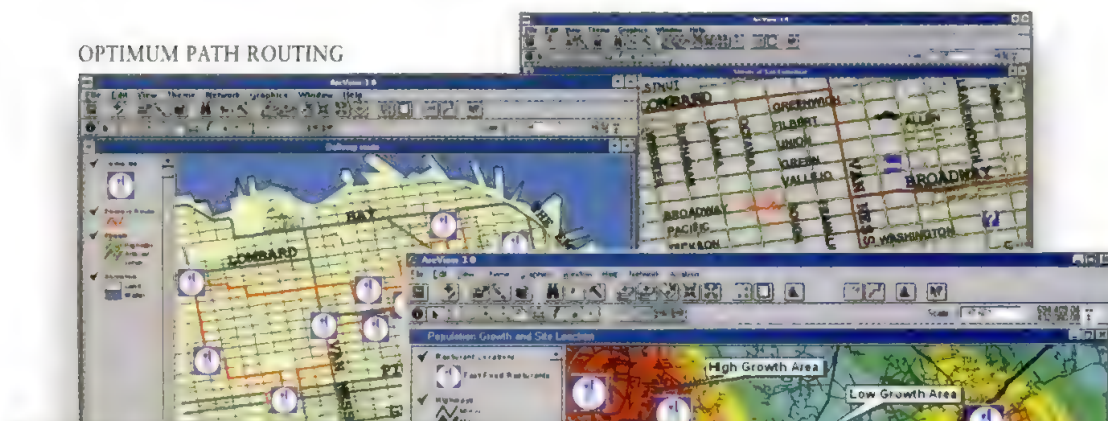


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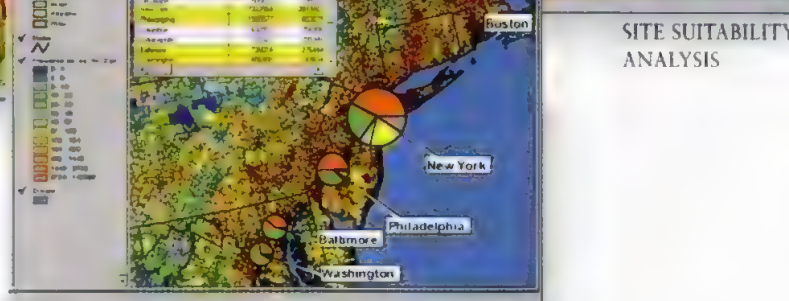
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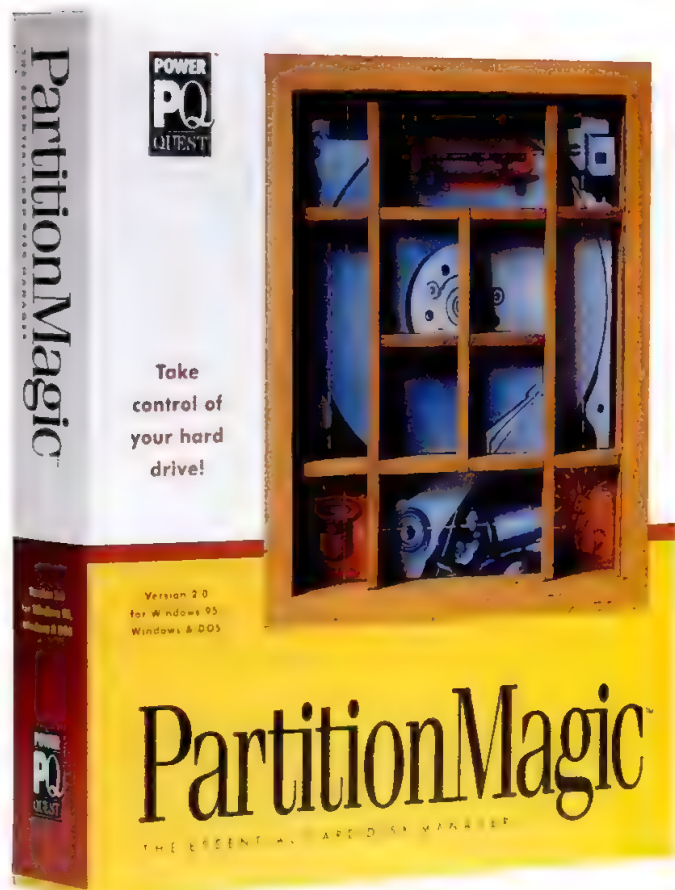
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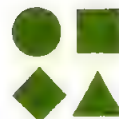
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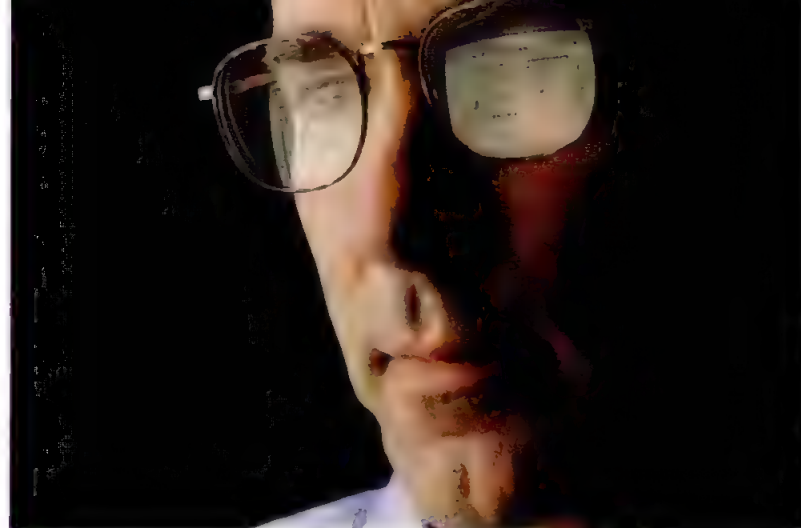
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including programs and database servers running on other machines, using all the interprocess communication mechanisms supported by the host operating system. So the spartan nature of the CGI interface confers a tremendous amount of flexibility.

On Unix machines, CGI programs are often implemented in Perl, a powerful interpreted language. It's extremely easy to use such languages in this fashion under Unix, where any text file can be marked as executable, possessing full peer status with binary programs in the eyes of the operating system. In order to execute such a program, known as a script, the operating system passes it to a shell or interpreter, which is selected according to the file's extension. For instance, a text file named `myprog.pl` is automatically passed to a Perl interpreter, which translates and acts upon the contents of the script. The Perl interpreter itself is implemented in C or some other compiled language.

Perl, a hacker's language if ever there was one, is easier to use than it is to describe. Perl has a diverse ancestry, to say the least,

and an eclectic assortment of commands, keywords, and features. Perl was originally created specifically for the automation of Unix system administration chores, and it has many facilities that are particularly well suited to text processing, not the least of which is support for associative or hashed arrays.

A huge number of Perl tutorials and refer-

ences and many sample Perl scripts are available on the World Wide Web, and even if you are not running your Web server under Unix, you will want to take advantage of these resources. Fortunately, versions of Perl are available on the Web for all the popular PC environments, including Windows and Windows NT.

To give you just a taste of CGI programs and Perl scripts, I have supplied an example HTML form, its associated Perl script, and screen shots of the form input and CGI output in Figures 1 through 4.

FURTHER READING

The most up-to-date information on Web publishing, HTML coding, and the Common Gateway Interface can be found on the Web itself, using the World Wide Web Consortium's home page, at www.w3.org, as a starting point. The CGI specification can be found, along with links to a large amount of supplementary material, at hoohoo.ncsa.uiuc.edu/cgi.

The following books are excellent aids for would-be CGI programmers:

- *CGI Programming on the World Wide Web*, by Shishir Gundavaram. O'Reilly and Associates, 1996. 433 pages. \$29.95. ISBN: 1-56592-168-2.

- *How to Set Up and Maintain a World*

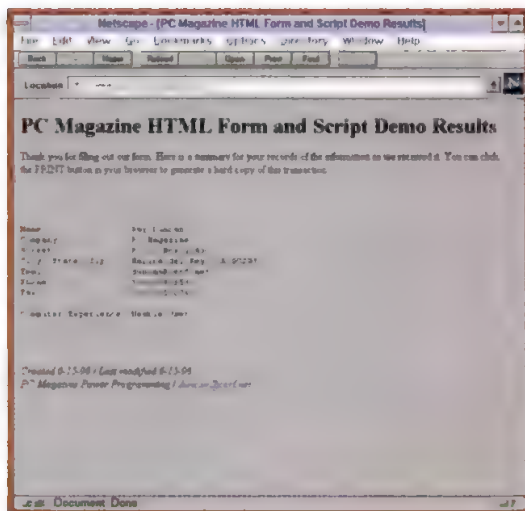


FIGURE 4: This Web page was generated as output by the Perl script in Figure 3.

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Wide Web Site, by Lincoln D. Stein. Addison-Wesley Publishing Co., 1995. 469 pages. \$29.25. ISBN: 0-201-63389-2.

An excellent resource for information about Perl is the Perl Language Home Page maintained by Tom Christiansen, at www.perl.com/perl. You will also want to pick up a copy of `cgi-lib.pl`, a popular and widely used library of Perl tools and subroutines written by Steven Brenner. You can get the latest version of `cgi-lib.pl` from Brenner's home page, at www.bio.cam.ac.uk/cgi-lib. If you are using the EMWACS Web server HTTPS for Windows NT, you will need to upgrade to HTTPS, Version 0.98 or later, from the EMWACS home page, at emwac.ed.ac.uk, then download the latest Windows NT version of Perl from ftp.process.com.

If you are seriously interested in Perl programming, I would recommend that you obtain one or both of the following books:

- *Learning Perl*, by Randal L. Schwartz. O'Reilly and Associates, 1993. 274 pages. \$24.95. ISBN: 1-56592-042-2.

- *Programming Perl*, Second Edition, by Larry Wall and Randal L. Schwartz. O'Reilly and Associates, 1996. Approximately 700 pages. \$39.95. ISBN: 1-56592-149-6. (As I write this, the first edition of this book is no longer in print, but the second edition is scheduled to be in bookstores by August 1996.)

Finally, I'd like to call your attention to a couple of fine reference books on HTML that have recently appeared. The rapid evolution of Web browsers, the uncertain state of the HTML standards process, and the all-out war between Microsoft and Netscape for Web browser mind share and market share have made it difficult for Webmasters to keep track of which versions of which browsers support which HTML tags and features (not to mention why). These books provide good descriptions of browser-specific HTML capabilities and guidance on how to write HTML code for the widest possible audience.

- *HTML: The Definitive Guide*, by Chuck Musciano and Bill Kennedy. O'Reilly and Associates, 1996. 385 pages. \$27.95. ISBN: 1-56592-175-5.

- *The HTML Sourcebook: A Complete Guide to HTML 3.0*, Second Edition, by Ian S. Graham. John Wiley & Sons, 1996. 688 pages. \$29.95. ISBN: 0-471-14242-5. □

Ray Duncan is a contributing editor of PC Magazine. You can send him any comments or suggestions you may have about the *Tutor* column by e-mailing him at duncan@cerf.net, or you can visit his Web page at www.ercb.com. Because of the volume of e-mail, every message may not receive a reply.



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PC Tech/Internet Tools

By Neil Randall

How DNS Servers Work

DNS tracks the name and address of every computer on the Internet.

Imagine, for a moment, that we had to address one another by our Social Security numbers. It would work for maybe the first ten people we got to know, but beyond that we'd likely never remember what to call anyone. Human beings, for many reasons, remember names better than numbers.

Switch to the Internet. You want to launch a telnet session, and you know the address of the telnet site at the National Center for Supercomputing Applications is *ncsa.uiuc.edu*. Then you decide to access the Microsoft Web site, and you guess that the address is probably *www.microsoft.com*, so you try it. It works, and you commit both addresses to memory.

What you've done, however, is simply memorize the *domain names* of the computers you're connecting with. From the Internet's standpoint, you haven't actually identified anything. Computers on the Internet are identified by numbers, not by names, and the domain name is merely a human-friendly pseudonym for the computer's real ID. On the Internet, each computer is assigned an Internet Protocol (IP) address, and this numeric identifier differentiates one computer from another. You may prefer to know them by name, but the Internet prefers the vital statistics.

WHAT'S IN A NAME?

An IP number comprises a four-part format, with each part of the address becoming increasingly machine-specific. For example, the IP number for Microsoft's Web server is 198.105.232.4, and the IP number for the *ncsa.uiuc.edu* machine is 141.142.2.2. Starting from the left, the first part of the number identifies the geographic region, and the second specifies the organization or provider. After that, it gets even more specific, with the third number denoting a group of computers, and the fourth the actual machine itself. For example, in the case of my own organization—the University of Waterloo, Canada—all computers share the first two portions of the IP address (129.97). The two machines in my office, 129.97.178.94 and 129.97.178.17, both belong to the 129.97.178 group; the final portions of the addresses are unique to either computer.

Why does this matter? Whenever you specify a domain name in a telnet, finger, Gopher, FTP, or Web session, the session doesn't actually begin until the domain name is translated into its IP address. This translation is the task of a Domain Name System (DNS) server or, as is more often the case, a series of DNS servers, in which the first queries the next until the correct IP number is acquired.

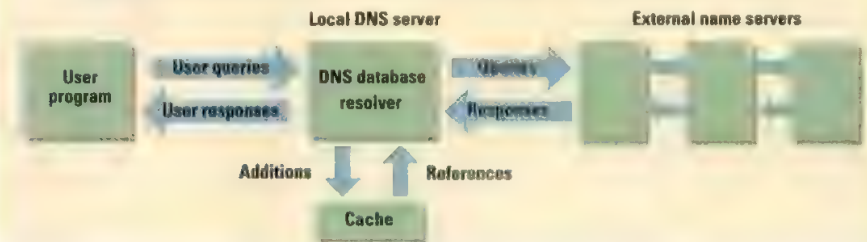
Whenever you attempt to send or request a piece of data that contains a domain name, the DNS sets its magic in motion. You can avoid the DNS entirely by foregoing the domain name in favor of the IP number, but that's unrealistic most of the time, especially since addresses to which you're sending data or requests (through e-mail replies or hyper-

Each person along the way would ideally store the knowledge for future reference so that the next time you needed the information, it would be available from the first person in the chain.

DNS servers around the world have to be made aware of changes as quickly as possible. Before DNS servers came along, domain name translation depended entirely on the *host table*, a text file stored in the */etc/hosts/* directory on your organization's Unix server, or in a relevant directory on your PC. The host table listed, line by line, Internet host names and their associated IP numbers. The master host table is compiled and stored on the machines at the Network Information Center (NIC)—*nic.ddn.mil*, in *netinfo/hosts.txt*, and one look at its half-a-megabyte size

THE DOMAIN NAME SYSTEM

DNS is a distributed database that holds the domain names and IP addresses of all the registered systems on the Internet. With servers located all over the world, DNS translates the names to addresses and back, enabling users to invoke an easy-to-remember name instead of a mysterious string of numbers.



link clicks, for example) are nearly always given to you in domain name format. As soon as you perform the action, you engage a piece of software, called a *resolver*, on the local machine that's been set up as a DNS server. The resolver, as its name suggests, tries to resolve the domain name, first by looking in its DNS database, then, if that doesn't work, by connecting to external DNS servers.

You can think of this process as similar to your attempts, as a new manager, to get information about a little-known company procedure. Your first step is to ask your secretary, who, if he or she doesn't know, would contact someone higher up the chain. That person would go a step higher, until eventually someone would be found who knew the answer.

will tell you why you wouldn't want the responsibility of maintaining this thing. As the Internet grows, domain names are added hourly (at least), and it's impractical for every host on the Internet to keep acquiring this file for its users.

DISTRIBUTED INFORMATION

The solution was the DNS server system. Unlike the host table, DNS servers don't rely on one large mapping file. Instead, DNS servers contain only a limited amount of information, because they know where to find details on domains they have yet to encounter. Whenever a DNS server gets a request for a host not contained in its *cache*, it simply does the sensible thing and asks someone who knows. That "someone" is an *authoritative* server, a server

responsible for maintaining DNS information. A server is authoritative if, when asked about an address in its domain, it can state with certainty that the name exists.

If the contacted server doesn't contain information for that domain name, it passes the request to an authoritative server higher up the chain, forming a series of queries that continues until the information is found. In practice, this means that the request can be handled by any number of servers, and that this sort of back-and-forth activity happens all day, every day on the constantly changing Internet. The server that originally made the request will cache the information to satisfy future requests without the need to go to an authoritative server. This information is set by the DNS server administrator to time-out after a specified period, to avoid the problem of fulfilling name requests with old data.

The DNS translation doesn't take long, but it does add to the time required for your request to reach the remote machine. You can perform a quick (though hardly foolproof) test of this yourself, by trying to access a Web site first using the domain name—*www.microsoft.com*, for example—then using the IP number—198.105.232.4. If you try this, however, be sure to close your browser and then reopen it to initiate a new session; otherwise, you'll simply load the cached version of the page. (And keep in mind that delays in loading can result from any of a number of factors, so take the results with a grain of salt.)

The most common software for DNS service is Berkeley Internet Name Domain, better known as BIND, originally from U.C. Berkeley but now sponsored by the Internet Software Consortium. The latest release, 4.9.3, contains the standard Unix version, plus a Windows NT port. BIND provides both resolver and name server software, with the resolver doing the actual queries and the name server providing the responses. BIND separates name servers into three types: the *primary* server contains all the data about a domain; the *secondary* server, in effect, copies the DNS database from the primary server; and the *caching-only* server builds a DNS database exclusively by caching queries. Only primary and secondary servers are considered authoritative for their particular domains.

To understand how DNS servers operate, it's necessary to understand the domain name hierarchy itself. At the top of the hierarchy is the *root* domain. Information on this domain

resides on a select number of root servers around the Internet. Below the root domain come the *top-level* domains, which are either country codes or organization codes. Examples of country codes are SG (Singapore) and CA (Canada), while organization codes include the well-known COM (commercial organizations), EDU (educational institutions), GOV (governmental organizations), and NET (network organizations), among others. (Note that top-level domains outside the U.S. are normally country codes, but that U.S.-based sites usually omit country codes.) Beneath the top-level domains are the *second-level* domains (*whitehouse.gov*; *microsoft.com*, *inforamp.net*), and then the *third-level* domains, and so on down the chain.

If you want to establish a domain name in the U.S., you must contact the Network Information Center (NIC). Before it grants your request, it will ensure first that the name you want isn't already in use, and second, that at least two servers currently in existence will serve the new domain name. When the NIC finally fills the request, it will grant you a second-level domain, and it will place pointers to that name in the servers for the top-level domain. For example, if you request the domain name *mybiz.com*, you must first get two name servers somewhere on the Internet to serve the information (your ISP's servers can handle this), and then NIC will place *mybiz* in the COM domain server system, with pointers to those two specified servers.

Once you have the domain in place, you can add any number of *subdomains* you wish. You might want to name one of your machines *sales.mybiz.com* and another *techsupport.mybiz.com* and so on. You don't need NIC approval for these, and, in fact, the NIC doesn't care. But if you want anyone to actually access your subdomains, you have to place information about them in the domain immediately above it. In this particular case, IP information about *sales.mybiz.com* and *techsupport.mybiz.com* must be placed in the servers for *mybiz.com*. Each server in the hierarchy contains a DNS database with entries called NS (name server) records, and each of these records contains the name of the domain or subdomain, plus

the name of the host that acts as a server for that domain or subdomain. In our example, we'll tell the root server that it can find information about *mybiz.com* and all its subdomains on our DNS server, located on the machine *details.mybiz.com*.

Let's see how this all works. Someone at a university on the other side of the country sees a link on a Web page that points to your brand-new subdomain, *techsupport.mybiz.com*. She clicks on it, and her local DNS server (most likely located on a machine at the university) kicks into gear. First, the server searches its own DNS database for the translation information, but because it's never encountered *techsupport.mybiz.com* before, the server has no record of that domain's existence and can't resolve the IP number. What is contained in its DNS database, however, is the address of a root server (all DNS servers must be set up with such a reference). The local DNS server goes out onto the Internet and queries that root server. The root server looks in its DNS database for the COM top-level domains, and it replies with the NS record that tells the university's DNS server to query *details.mybiz.com* for information about *mybiz.com*. The university's server does so, and learns from *details.mybiz.com* the correct IP address for *techsupport.mybiz.com*. At all stages in this process, the university's DNS server is caching the NS records so that the next time anyone from the university needs an IP translation for *mybiz.com*, *details.mybiz.com*, or *techsupport.mybiz.com*, the information will be available locally.

As with other Internet protocols, the DNS is outlined in several Internet Request For Comments (RFC) documents (initially in RFC 882, 883, and 973). To understand the workings of a DNS server, however, RFC 1035 is your best bet. Although you can find RFC 1035 in several places on the Internet, a nice HTML version is available at

www.crynwr.com:80/crynwr/rfc1035/. As you might expect, the RFC is quite technical, and you may not be interested in gaining more than a general sense of how a DNS server operates. But keep the RFC in mind in case somewhere along the line, you decide to become a server administrator. □

Neil Randall has authored and coauthored several books about the Internet, including *Using Microsoft FrontPage, Special Edition*, the recent *Guide to Netscape Navigator Gold*, and the upcoming *The Soul of the Internet*. He can be reached at nrandall@mariner.uwaterloo.ca.

DNS servers contain only a limited amount of information, because they know where to find details on domains they have yet to encounter.

BIND provides resolver and name server software, with the resolver doing the actual queries and the name server providing the responses.

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NETSCAPE





By Gregory A. Wolking

BootOpt Gives You Start-Up Control

A GUI interface makes it easier to set Windows 95's start-up options.

Microsoft Windows 95 is a powerful operating system, offering many options to control its behavior on start-up. Unfortunately, the only way to change these options is by editing a plain-text file, `Msdos.sys`, which is hidden from the average user to prevent tampering. `Msdos.sys` is structured like an `.INI` file, and it's not difficult to edit the file once you make it visible. The hard part is learning and remembering what the various settings are and how they interact. That's why I wrote this issue's utility, **BootOpt**, a graphical interface for `Msdos.sys`.

You can obtain **BootOpt** by downloading it from PC Magazine Online or by mail. (Refer to the sidebar "Guide to Our Utilities" for details.) The source code for **BootOpt**, which was written in Microsoft Visual C++, is also provided, for those interested in seeing how it works.

WHAT'S IN MSDOS.SYS

The `Msdos.sys` file is located in the root directory of your boot drive. It is usually marked with the Hidden, System, and Read-Only attributes so that you can't see it in a normal directory listing. If you want to edit the file, you can use the `ATTRIB` command to remove these attributes to make the file visible.

The file is structured just like a standard Windows `.INI` file (see Figure 1). It contains two sections, `[Paths]` and `[Options]`. The settings in the `[Paths]` section tell Windows where it can find its components during start-up. The `[Options]` settings control how Windows behaves.

The file also contains a large block of comments, which begins with a rather ominous-sounding warning:

```
;The following lines are required for
;compatibility with other programs.
;Do not remove them (MSDOS.SYS needs
;to be >1024 bytes).
```

Comments (lines beginning with a semi-colon) are not usually important to an `.INI` file, but `Msdos.sys` is an exception to the rule. Those of you familiar with DOS will notice that this file has the same name as one of DOS's system components. Some software installation programs rely on detecting the pres-

ence and size of `Msdos.sys` to verify that the computer is running the correct version of DOS, so the file is padded with comments to make sure that it's longer than 1024 bytes.

The `[Paths]` section of `Msdos.sys` contains the following keys:

```
HostWinBootDrv=
WinBootDir=
WinDir=
```

The Windows Resource Kit (WRK) says that `HostWinBootDrv=` determines the root directory of the boot drive, but actually, it contains the letter of the drive on which Windows

which allow settings such as "Yes" and "No" or "True" and "False" for Boolean keys, the keys in `Msdos.sys` require either "0" or "1." All keys have a default value that Windows will use if the key is not specified in the file. The WRK contains a list of these keys, but it is neither complete nor entirely correct. The table "The MSDOS.SYS Settings" gives a listing of the keys showing their default values and a brief description of their meanings.

BOOT MENU SETTINGS

`BootKeys=` is enabled by default and determines whether or not you can use boot-option function keys while the "Starting Windows 95" message is displayed. Specifically, F8 will activate the start-up menu, F6 will step through your `Config.sys` and `Autoexec.bat` commands one by one, F5 will start the system in safe mode, Shift-F5 will start in safe mode but stop at the command prompt, and (if the dual-boot option is enabled) F4 will boot your pre-Windows 95 version of DOS. Disabling `BootKeys` serves as a security measure, preventing users from accessing these advanced functions. In other words, when this setting is disabled, the settings for `BootDelay=`, `BootMenu=`, `BootMenuDefault=`, `BootMenuDelay=`, and `BootMulti=` are ignored.

The `BootDelay=` setting determines how long the "Starting Windows 95" message remains visible, giving you time to press a function key. The default setting for `BootDelay=` is 2 seconds. The WRK says that if you set this value to 0, the "Starting Windows 95" message doesn't appear. What it *doesn't* say is that you can still use a function key if you're quick. You just have to hit the key immediately after your computer beeps to indicate that the power-on self-test (POST) is complete.

Enabling `BootMenu=` forces display of the start-up menu every time the system starts. The start-up menu may contain from six to eight items, depending on what other options are set. Figure 2 shows the start-up menu with all possible options activated.

`BootMenuDefault=` determines which menu item will be selected if you don't make a choice before the time specified by the `BootMenuDelay=` setting expires. The default setting for `BootMenuDelay=` is 30 seconds. The

IN THIS ISSUE

BootOpt

BootOpt provides a graphical interface to help you manage the settings in your MSDOS.SYS file. It also provides a quick and easy way to restart your system using different combinations of those settings.



95 is installed. If Windows 95 is installed on a compressed drive, this key will contain the letter of the host drive for that compressed drive. `WinBootDir=` tells the name of the directory in which Setup places the various Windows 95 start-up files, while `WinDir=` contains the name of the Windows "home" directory. Windows also uses `WinDir=` to set the default values for environment variables such as `TEMP`, `TMP`, and `COMSPEC`. It is best not to tamper with the values in the `[Paths]` section. Management of those values should be left to Windows Setup. An incorrect setting here virtually guarantees that your system will not boot from the hard disk.

The `[Options]` section of `Msdos.sys` can contain a number of keys. These keys all use numeric values. Most of these are Boolean values, with 0 meaning disabled and 1 meaning enabled. Unlike some other `.INI` files,



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[illegible]

FIGURE 1: This is the Msdos.sys file on my computer. Notice the comments used to pad the file length to over 1,024 bytes.

default setting for `BootMenuDefault=` is 1 (normal). The WRK says that the default is either 3 (safe mode) or 4 (safe mode with network support), depending on whether or not the `Network=` setting is enabled. This is misleading, as it applies only if the last boot attempt failed. Note that you have to be careful when changing `BootMenuDefault=` manually because the `BootMulti=` and `Network=` settings affect the organization of the menu.

WINDOWS START-UP SETTINGS

Enabling BootGUI= tells your system to start the graphical Windows 95 interface. If your system has an Autoexec.bat file, Windows accomplishes this by issuing the WIN command after Autoexec.bat finishes, so you should never include the WIN command in your Autoexec.bat file. If you disable this option, the system will stop the boot process at the command prompt, as if you had selected "Command prompt only" from the start-up menu.

Enabling Logo= (as you might have guessed) displays the animated logo as Windows processes Config.sys and Autoexec.bat. In order to stifle any screen output as these files run, Windows redirects a number of low-

level system interrupts. This can make life difficult for some memory managers and network operating systems. If you're having trouble with that type of software, disabling this option may improve your situation.

TROUBLESHOOTING SETTINGS

The keys in this section are meant for troubleshooting and special situations. The average user won't ever need to change them from their defaults, but if the situation arises, it's important to know what these settings do.

Enabling BootWin= tells the bootstrap loader to start Windows 95. If your computer is set up for dual boot and you disable this option, your computer will boot to the pre-Windows 95 version of DOS. Disabling this option without a properly installed "old DOS" results in a computer that won't start from the hard disk. This may seem disastrous, but recovery is not difficult, as long as you have a boot disk. When BootWin= is disabled, Windows 95 renames its Msdos.sys file to Msdos.w40, and replaces Msdos.sys with the DOS version. Once the files have been renamed, Windows reads Msdos.w40 to get its start-up settings. Therefore, you can resume booting Windows

95 by editing Msdos.w40. Either delete the BootWin= key or change its setting to 1, then reboot the machine.

If you have dual boot installed, enabling `BootMulti=` gives you the option to boot to old DOS. You can do this by pressing F4 during start-up, or by selecting "Previous version of MS-DOS" from the start-up menu. This is similar to disabling `BootWin=`, the difference being that `BootWin=` makes your original DOS version the default while `BootMulti=` just makes it an option. If `BootKeys=` is disabled, `BootMulti=` has no effect.

Enabling BootSafe= (the WRK wrongly denotes this key as "BootFailSafe=") has the same effect as selecting "Safe Mode" from the start-up menu. Safe mode is intended mainly for correcting problems that prevent your system from booting normally, but it can also be used by installation programs or system utilities that must alter or replace files that would otherwise be locked during normal operation. You may have seen this option in action if you've ever used DriveSpace to compress the volume on which Windows is installed. Safe mode differs from normal mode in several important respects:

- If safe mode is forced via `BootSafe=1`, the start-up menu is bypassed and the start-up function keys are ignored.
- `Config.sys` and `Autoexec.bat` are bypassed.
- The Registry is not processed.
- The `[Boot]` and `[386Enh]` sections of `System.ini` are bypassed.
- On networked PCs, network drivers are not loaded and `Netstart.bat` is bypassed unless you're using the "Safe Mode with network support" option from the start-up menu.
- The only device drivers loaded are those for the mouse, the keyboard, standard VGA display, `Himem.sys` (with extended memory test), and `Ifshlp.sys`.

Enabling `BootWarn=` displays a warning message box whenever the system starts in safe mode and places the words “Safe Mode” in all four corners of your desktop background as a constant reminder that you are not running in normal mode.

DblSpace= and **DrvSpace=** control the loading of Microsoft's disk compression drivers, **Dblspace.bin** and **Drvspace.bin**. If these options are disabled, you cannot access any of your compressed volumes. If Windows itself is installed on a compressed volume or the boot drive itself is compressed, you can still boot the system, but only in safe mode. This is possible because Windows keeps a "bare bones" set of start-up files in the uncompressed portion of the boot drive.

Enabling DoubleBuffer= loads the 32-bit double-buffering device driver for SCSI drives. This option is normally set, if necessary, during the installation of your SCSI host adapter. If the double-buffering option was turned on during installation of a SCSI drive,

THE MSDOS.SYS SETTINGS

Key	Type	Default	Effect
BootDelay=	Value	2	Sets initial start-up delay.
BootGUI=	Boolean	Enabled	Starts the graphical interface.
BootKeys=	Boolean	Enabled	Enables function keys at start-up.
BootMenu=	Boolean	Disabled	Forces display of the start-up menu.
BootMenuDefault=	Value	1	Sets default selection for the start-up menu.
BootMenuDelay=	Value	30	Sets start-up menu delay.
BootMulti=	Boolean	Disabled	Enables dual-boot option.
BootSafe=	Boolean	Disabled	Starts Windows 95 in safe mode.
BootWarn=	Boolean	Enabled	Displays warning message in safe mode.
BootWin=	Boolean	Enabled	Sets default operating system.
DbiSpace=	Boolean	Enabled	Loads DBLSPACE.BIN.
DisableLog=	Boolean	Unknown	Not documented.
DoubleBuffer=	Boolean	Disabled	Loads double-buffering driver for SCSI drives.
DrvSpace=	Boolean	Enabled	Loads DRVSPACE.BIN.
LoadTop=	Boolean	Enabled	Loads COMMAND.COM at the top of memory.
Logo=	Boolean	Enabled	Enables the animated logo.
Network=	Boolean	Unknown	Enables safe mode with network support option.
SystemReg=	Unknown*	Unknown	Not documented.

For Boolean values, disabled = 0, enabled = 1

* Possibly Boolean.

turning it off may prevent the drive from working properly. If you don't have any SCSI drives, you should leave this setting disabled.

Enabling LoadTop= causes Command.com and your disk-compression drivers (if in use) to be loaded at the top of conventional RAM as Config.sys is being processed. Like the Logo= setting, this may interfere with third-party memory managers, device drivers, and network drivers (NetWare in particular) that expect this memory region to be available. If you're having trouble using this type of software, disabling this option may solve some of your problems.

The only purpose of the Network= key is to add the "Safe Mode with networking" option to the start-up menu. On networked systems, its default is enabled. On non-networked systems, its default is disabled. The most common use of this setting is by network administrators. If this option is disabled on a networked PC, the PC cannot access the network unless the system is started in normal mode.

By poking around in Io.sys with a binary editor, I discovered two additional keys that are not documented in the WRK: DisableLog= and SystemReg=. After much experimentation, I determined that these keys accept Boolean values, but I do not know what their default settings are or what functions they provide.

USING BOOTOPT

Before I discuss how to use BootOpt, please note: Misusing the settings that BootOpt controls can prevent your system from operating properly. Before you use the program, you should carefully read either this article or the online help.

To install BootOpt, place its three program

files, Bootopt.exe, Bootopt.hlp, and Bootopt.cnt, in the directory of your choice, then create a shortcut to Bootopt.exe. When you first start BootOpt, the dialog box displays your current Msdos.sys settings (see Figure 3). The Profile Name list box reflects this by displaying "(Current file settings)." This entry does not represent a separate physical profile, so you can't delete or overwrite it. If you select it from the list, BootOpt will reread Msdos.sys and display its settings in the dialog box.

I designed BootOpt with safety in mind. The very first time you run BootOpt, it reads your Msdos.sys file and saves its [Options] settings in a profile named "(Original)." You cannot delete or overwrite this profile except by editing your system Registry. Thus, you always have a way to get your Msdos.sys file back to its original state, no matter how much you may have tweaked it.

If Msdos.sys is missing or damaged when the program starts, BootOpt checks the Registry to see if the "(Original)" profile can be

Normal
Logged (\BOOTLOG.TXT)
Safe mode
Safe mode with network support
Step-by-step confirmation
Command prompt only
Safe mode command prompt only
Previous version of MS-DOS

Item 4 appears only if the Network= setting is enabled. If Network= is disabled, items 5-8 are renumbered to 4-7.

Item 8 (7 if Network= is disabled) appears only if BootMulti= is enabled.

FIGURE 2: This is what your start-up menu looks like if all possible options are enabled in Msdos.sys. Note how changing some of the file settings changes the menu's contents.

loaded. If so, it presents an appropriate message and lets you choose whether or not to use that profile to restore the file. If you decline, BootOpt loads the (Original) profile but does not recreate Msdos.sys. If you click Apply Settings, Msdos.sys will be re-created. If the Registry is so badly mangled that BootOpt could not load the (Original) profile, the program presents an appropriate message and shuts down.

You can select the settings you want for Msdos.sys using BootOpt's check boxes, list boxes, and radio buttons. For safety, your changes will not be applied until you click the Apply Settings button and acknowledge the confirmation message. When you do, BootOpt automatically stores a backup copy of Msdos.sys under the name Msdos.bkp. (Windows Setup uses the .BAK extension, so I used .BKP instead.) If BootOpt is unable to create the backup for any reason, it will not touch Msdos.sys. If any problems occur while writing the new copy of Msdos.sys, BootOpt will automatically restore the backup copy of the file.

You may store the settings you select in a named profile by clicking the Save As button, entering a valid name, and clicking the OK button. As you enter or edit the name, the OK button will become disabled if the name is invalid. To be valid, the name cannot be blank, and it cannot be set to "(Original)" or "(Current file settings)." The name also cannot include the backslash character (\), but the edit box itself takes care of filtering out any backslashes (more on this a little later). Profile names can be up to 40 characters long, and leading or trailing spaces are ignored. Although BootOpt preserves upper and lower case in profile names for readability, the names are not case-sensitive.

Note that BootOpt doesn't give you direct control over the [Paths] section of Msdos.sys. It reads these settings and stores them in the Registry the first time you run the program. Then, on subsequent runs, BootOpt gets the [Paths] settings from the Registry whenever it rewrites Msdos.sys.

I know of only two situations in which these

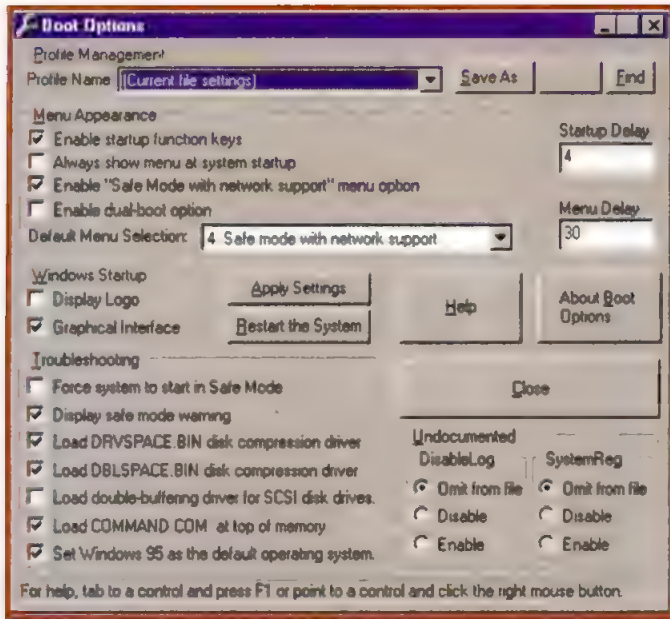


FIGURE 3: Here is BootOpt's dialog layout. Note the Help button for general help; you can also use the right mouse button to get context-sensitive help for a specific control.

settings *should* change: when you reinstall Windows 95 to a different hard disk or directory, and when you use DriveSpace to compress (or decompress) either the boot drive or the drive on which Windows is installed. To handle this possibility, when BootOpt starts (except for the very first time), it compares the settings currently in the file to those it stored in the Registry. If it was able to read all three keys from the file and they don't match the Registry, BootOpt will present a message box allowing you to decide whether or not to update the Registry data. Naturally, if you have just made one of the aforementioned changes to your system configuration, you should answer "Yes" to this message.

The Find button helps to eliminate redundancy in your saved profiles. When you're ready to save a profile, click the Find button first. BootOpt will check all of your existing profiles against the current dialog settings. If it finds a match, it will set the Profile Name field appropriately. Note that this function finds the special "(Original)" profile only if that's the only one that matches.

To load a profile, open the Profile Name list and select a name. Loading a profile does not affect Msdos.sys, only the dialog box settings. If you want to put the profile into effect, you must click the Apply Settings button. Once you load the profile, its name remains visible in the Profile Name box until you change one of the dialog box settings. If you should change the settings back to match the last profile you loaded or saved, that profile's name will reappear.

To delete a profile, first load it, then click the Delete button. Deleting a profile affects neither the current dialog box settings nor the con-

tents of Msdos.sys. When launched with no command line arguments, BootOpt runs interactively. Command line switches let you use BootOpt in automatic mode; upper and lower case is ignored. These are the switches that BootOpt recognizes:

- /RESTART tells BootOpt to restart the system. BootOpt will warn you that the system is about to restart and give you a chance to cancel, unless you also use the /SILENT switch.

- /PROFILE:[profile name] tells BootOpt to load the specified profile and use it to rewrite Msdos.sys. If

you combine this switch with /RESTART and cancel the operation, Msdos.sys will not be rewritten. Do not place quotes around the required [profile name] argument, even if the name contains punctuation, embedded spaces, or other special characters. If used, this switch must appear last on the command line.

- /SILENT tells BootOpt to perform the above without prompting you unless a critical error occurs.

Profiles come in handy when you use the program in its automatic mode. To restart your system quickly using a particular Msdos.sys configuration, create a shortcut to BootOpt and add the appropriate command line switches. You can also place a shortcut to BootOpt in your start-up folder to have your Msdos.sys file reset to the desired state each time your system starts. This is useful if you need a special Msdos.sys configuration to run a particular application—for example, an application that requires your old version of DOS. You don't have to worry about restoring Msdos.sys manually before you shut the system down.

For online information about any of the dialog settings or commands, tab to the related control and press F1 for context-sensitive help, or point to a control or its label with the mouse, click the right mouse button, then select "What's this?" from the context menu for pop-up help.

PROGRAM DESIGN

From a programming standpoint, BootOpt is fairly simple. The greatest obstacle I had to overcome was getting context-sensitive help to work the way I wanted it to. The Microsoft Foundation Classes (MFC) and the App Wiz-

ard included with Visual C++ made designing the basic application very easy, but the built-in help mechanism for dialog-based applications left much to be desired. In particular, MFC treats a dialog box as a single object, providing only one context ID for WinHelp to use. It's up to the dialog box itself to alter that context based on its current state. This is done with the SetHelpID() member function. Unless you add code to the dialog box that calls SetHelpID() each time the input focus changes, F1 help isn't really context-sensitive at all—the user gets the same help topic no matter which control has the input focus. Also, MFC does not include support for pop-up help, so I had to build that on my own.

One nice feature of MFC is its built-in F1 help support for message boxes. This eliminates the need for message boxes that read like the fine print on a software license agreement. You can place a short, concise message in the resource string, then let the user hit F1 for additional information. To use this feature, you create message boxes with MFC's AfxMessageBox() function instead of the Windows API MessageBox() function. The string used for the message-box text is associated with an integer identifier. If the user presses F1 while the message box is active, MFC launches WinHelp with a context ID based on that integer identifier.

My first solution to the "one context for the whole dialog box" problem was to add a handler to the dialog box itself for the ID_HELP message, which is generated by the MFC application framework when the user presses F1. That worked, but it killed the built-in F1 help for message boxes. Although the CDialog and CWinApp classes are both derived from the CCmdTarget class, they each have their own versions of the OnHelp() member function used to handle the ID_HELP message. CWinApp::OnHelp() recognizes whether or not a message box is active when F1 is pressed; CDialog::OnHelp() does not. In other words, different MFC classes provide different levels of help support. I decided to use this to my advantage.

To keep F1 help support for message boxes, I had the main application class, CBootOptApp (which is derived from CWinApp), handle the ID_HELP message by adding the appropriate macro to CBootOptApp's message map. The default macro presented in the online help for MFC links this message to the CWinApp::OnHelp() function. Since CWinApp::OnHelp() didn't do what I wanted, I wrote my own event handler, CBootOptApp::OnHelp(), and modified the macro to point to my function instead. CBootOptApp::OnHelp() determines the correct context ID to pass to WinHelp using only half-a-dozen lines of code. This is far more efficient than burdening the CBootOptDlg class with OnSetFocus() han-

dlers by calling SetHelpID() for each and every control the dialog box contains.

To implement pop-up help, I began by using the Component Gallery in Visual C++ to add a context menu to the main dialog box. I edited the default menu provided so that it contained only one item, "What's this?", and assigned the ID_HELP_USING identifier to it. Next, I activated the dialog-box messages ID_HELP_USING and ID_CONTEXT_HELP by adding the appropriate macros to the CBootOptDlg class's message map. Normally, MFC generates the ID_HELP_USING message when the user selects "Help on Help" from an application's Help menu, and it generates the ID_CONTEXT_HELP message when the user presses Shift-F1 or clicks the question-mark icon in the title bar. Since this program doesn't have a help menu and the CDialog class doesn't support either the question-mark icon or Shift-F1 help, it doesn't use these messages. So I decided to hijack them for my own use in the context menu.

When the user clicks the right mouse button over the dialog box, MFC sends the WM_CONTEXTMENU message to the dialog box, which then calls the OnContextMenu() function, the original version of which was created automatically by the Component Gallery. I modified the supplied code to use the mouse coordinates to determine which control (if any) the mouse was over. If the

THE TOP 10 UTILITIES

- 1 **CHECKE** Windows checkers game
- 2 **SCINVO** Invokes screensaver
- 3 **PICALB** Organizes image files
- 4 **FDDLLS** Finds dead DLLs
- 5 **WINBAR** Taskbar for Windows 3.1
- 6 **SPAD** Enhanced Windows notepad
- 7 **WSWIN** Enhanced search tool
- 8 **1MBFORT** Fortifies low memory
- 9 **APPOIN** Windows appointment book
- 10 **INCTRL2** Controls Windows installs

mouse was over either the title bar or an open area of the dialog, I simply exit the function before creating the menu. Otherwise, I get the identifier of the control the user is pointing to and store it for later use. If the control is disabled, I add a "Why is it disabled?" item to the pop-up menu associated with the ID_CONTEXT_HELP message.

With the control identifier stored and the menu appropriately built, I let execution continue into the Component Gallery's code, activating the menu. If the user clicks outside the menu or presses Esc, the menu simply closes. If the user selects an item from the menu, the menu posts the corresponding command message to the dialog box's main window, activating either the OnHelpUsing() or OnContextMenu() event handler. Again, since I did not want to use the MFC implementations of these functions, I wrote my own versions and modified the message map macros to point to my versions instead of the base-class versions. My versions of these functions simply launch WinHelp, passing the context ID stored by OnContextMenu().

FILTERING PROFILE NAMES

A third problem was filtering the input field for profile names. Since a profile's Registry key has the same name as the profile itself, the profile name cannot include the backslash character, because backslashes separate key names in a Registry path. At first I used the dialog box itself to filter out backslashes by trapping the standard notification message EN_CHANGE, sent to an edit control's owner when the control's text changes. That was inefficient because it required retrieving, examining, and possibly updating the control's en-

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tire contents every time the user typed a character into the field, and it was clumsy because of the gymnastics required to keep the edit cursor from jumping to the beginning of the field every time the user typed or pasted a backslash. It seemed much more logical to have the control filter its own keyboard input and to send a notification message to the dialog box only if a keystroke was accepted and actually changed the control's contents. To accomplish this, I designed my own class, CFilterEdit, derived from MFC's CEdit class.

Those of you who use Visual C++ may find this class useful. A CFilterEdit control acts exactly like a CEdit control except that you can specify a string of characters to be excluded from the control's input. I added the member functions SetFilterText() and GetFilterText() to set and retrieve the filter's contents. SetFilterText() is overloaded to accept either a string or an integer as its first parameter. Pass-

ing a string sets the filter text explicitly, while passing an integer allows use of eight predefined filter strings (for instance, uppercase alpha, lowercase alpha, digits, and so on) either alone or in combination. It also accepts two Boolean parameters. The first parameter determines whether the filter is inclusive or exclusive and the second determines whether or not the new filter is applied to the control's contents immediately instead of waiting until the text actually changes due to user input. BootOpt itself doesn't really need all of these bells and whistles, but as long as I was creating the class I figured I might as well make it a full-fledged reusable component.

To achieve the filtering, I overrode the CEdit base class's OnChar() and OnUpdate() member functions. OnChar() filters out characters typed at the keyboard while OnUpdate() filters text pasted in from the clipboard. The CFilterEdit class is implemented in the Myedit

.cpp and Myedit.h files, and the source code comments give details on how to use it in your own project.

If you're interested in learning more about how BootOpt works, the thoroughly commented source code is available online in Bootsrc.zip. When you extract this archive, be sure to use PKUNZIP's -d option to re-create the necessary subdirectory structure.

BootOpt controls a crucial system file in Windows 95 and can create havoc if used incorrectly, but the built-in protections make it safe; you can always get back to your original Msdos.sys. In addition to providing a user-friendly interface for an obscure part of Windows 95, BootOpt documents and explains all the available options in Msdos.sys. □

Gregory A. Wolking is the primary sysop of the Utilities/Tips Forum of ZD Net on CompuServe.

GUIDE TO OUR UTILITIES

BootOpt, Version 1.0...

PURPOSE BootOpt provides a graphical interface to help you manage the settings in your Msdos.sys file. It also provides a quick and easy way to restart your system using different combinations of those settings.

USAGE Be warned: Misusing the settings BootOpt controls can prevent your system from operating properly. Before you use the program, you should carefully read either the accompanying article or the online help.

To install BootOpt, place its three program files, Bootopt.exe, Bootopt.hlp, and Bootopt.cnt, in the directory of your choice, then create a shortcut to Bootopt.exe. When you start BootOpt, it displays your current Msdos.sys settings. You can select the settings you want using BootOpt's check boxes and radio buttons. For safety, your changes will not be applied until you click the Apply Settings button.

You may store the settings you select in a named profile by clicking the Save As button, entering a valid name, and clicking the OK button. To load a profile, open the Profile Name list and select the one you want. To delete a profile, first load it, then click the Delete button. Use the Find button to see if any of your saved profiles match the current dialog-box settings.

For information about any of the dialog-box settings or commands, tab to the related control and press F1 for context-sensitive help, or point to a control or its label with the mouse, click the right mouse button, then select "What's this?" from the context menu for pop-up help.

Command line switches let you use BootOpt in automatic mode. (Note that case is ignored.) These are the switches that BootOpt recognizes:

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/RESTART and cancel the operation, Msdos.sys will not be rewritten. Do not place quotes around the required [profile name] argument, even if the name contains punctuation, embedded spaces, or other special characters. If used, this switch must appear last on the command line.

- /SILENT tells BootOpt to perform the above without prompting you unless a critical error occurs.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

User-to-User

By Neil J. Rubenking

Split Large Files over Several Disks with PKZIP

PKZIP 2.0 includes a feature called disk spanning that allows a .ZIP archive file to occupy multiple disks. I already have some large .ZIP archives on my hard disk, however, and I found out that you can't apply the spanning feature after you've already created a .ZIP file. I thought of unzipping each file and then recreating it using the spanning feature, but then I found a faster workaround.

If you zip an existing file under a new name using disk spanning—but with no compression set—you can split an existing .ZIP file so that it will span multiple disks. I do this often now with large archives in which I don't want to break the PKZIP verification. In addition, I've found I can give my newly spanned .ZIP files more meaningful names using this method.

PAUL D. OWENSBY, via ZD Net

PC MAGAZINE: The PKZIP utility is extremely popular for compressing and organizing files for downloading. Because the files are compressed, you reduce your download time. And, because they're grouped together in a single archive, you can be sure you've downloaded all of the necessary files. With the addition of the disk-spanning feature, PKZIP also becomes a useful tool for transferring files using the smallest possible number of floppy disks.

PKZIP's -e command line switch lets you select the compression method. When splitting a file you've already compressed, you'll specify no compression by using -e0 (zero). The -s command line switch invokes the disk-spanning option. That's all you need if you're using freshly formatted disks. To unconditionally format the disks before storing the .ZIP file on them, you use -su.

Suppose you have a multimegabyte file named REALBIG.ZIP on your hard disk, and you want to use some recycled floppy disks to transfer this file to another computer. Here's the command you would use:

```
PKZIP -e0 -su A:TRANSFER REALBIG.ZIP
```

Of course, PKZIP 2.0 must be available on the destination machine. After reassembling REALBIG.ZIP, you will extract the compressed files it contains. Thus, you'll need enough hard disk space to hold the .ZIP file and its contents.

Note that PC Magazine's SLICE utility can also split up a large file onto several disks. And the recipient will always have the tools needed to restore the split-up file, as SLICE automatically creates the SPLICE utility on the first disk. You can download SLICE from PC Magazine Online.

Extracting Files from The Windows 95 CD-ROM

I am notorious for deleting text files from my hard disk to reclaim valuable disk space, so after reading through all the .TXT files in my Windows 95 directory, I deleted them. Several months later, I needed to look at the files for information on known compatibility problems. Driven by panic and necessity, I discovered the following technique for retrieving the text files from the compressed Windows 95 .CAB files located on the Windows 95 CD-ROM install disk:

- Put the Windows 95 CD into the CD-ROM drive and let the auto-play feature bring up the opening screen. Click on the Browse CD button to get to the file folders, then double-click on the Windows 95 folder—it contains the .CAB files. Through trial and error, I discovered that the file WIN95_03.CAB contains all the text files I needed.
- Double-click the .CAB file, and a new view window opens, allowing you to see its contents. Most of the normal viewing options, such as filtering and sorting, are disabled in the new view window, so finding the files you need is tedious.
- When you find a relevant file, double-click on it. A dialog box will open, allowing you to choose a drive and a folder into which you can copy the selected file. Click on OK, and the selected file or files will be copied to your desired folder.

As far as I can determine, this technique can be used to retrieve any file from the Windows 95 .CAB files.

GARY COLNAR, Walsenburg, Colorado

HIGHLIGHTS



HARDWARE Get the facts about fonts. If you're a Windows user, there are some things you should know about scalable fonts. *Page 234*



OPERATING ENVIRONMENTS Find out why the copy protection on your Windows 95 CD-ROM may be more of a nuisance to you than to a would-be thief. *Page 242*



WORD PROCESSING You can change bullets in Ami Pro 3.1 using the Find and Replace command, but you'll need to know this trick first. *Page 248*

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PC DIRECT starts here with exciting offers from top direct vendors. See index, page 234.

PC MAGAZINE: The Windows 95 CD-ROM devotes over 30MB of space to 19 .CAB (short for cabinet) files. All but five of the .CAB files are 2MB in size. Loading one of these monstrous files to browse its contents can take a bit of time, and locating a specific file requires sharp eyes. Rather than poring over the contents of each .CAB file, you can ask Windows 95 itself to find the correct one!

Bring up the Start Menu and select Files or Folders from the Find menu. Press the Browse... button and choose the Windows 95 directory on the CD-ROM drive. In the box labeled Named:, enter *.CAB. Now flip to the Advanced tab and enter the name of the file you're seeking on the Containing text line. Click the Find Now button, then go do something else while Find crunches away. Once Find has located the correct .CAB file for you, follow the instructions above to extract the file.

Environment Variables Don't Expand in Config.sys

While trying to eliminate my Autoexec.bat file under Windows 95, I discovered a limitation in recent enhancements to Config.sys. I'm sure you already know that you can SET environment variables right in your Config.sys. Well, I had just installed an application that put a bunch of SET statements in my Autoexec.bat file, so I cut them and pasted them to the end of my Config.sys, which already had a SET PATH= command in it. One of the statements the application inserted was SET PATH=C:\WHATEVER;%PATH%. Everything looked good as I rebooted—until the system abruptly stopped at the DOS prompt and announced it couldn't find WIN.COM.

It turns out that Config.sys doesn't know how to resolve environment variables in commands; it just SETs them.

LARRY SELTZER, via the Internet

PC MAGAZINE: DOS 6 introduced a number of enhancements to Config.sys, including the ability to SET environment variables. But because each RAM-resident program gets its own personal copy of the environment, filling up the environment before loading TSRs is wasteful. Memory-thrifty DOS users avoided this feature, preferring instead to SET environment variables at the end of Autoexec.bat.

On the other hand, when your aim is to eliminate Autoexec.bat entirely, setting up the environment in Config.sys makes perfect sense. The only limitation, as noted above, is that a variable name enclosed in percent signs will not be replaced by its value when the line is processed. You need to spell out the full

value of the variable you want to set. So, for example, rather than adding a line like SET PATH=C:\WHATEVER;%PATH%, you would simply edit the existing SET PATH= line to include the new directory.

Give Windows 95 A Windows 3.x Look

Ever since I upgraded my machine to Windows 95, I've been disappointed with its lack of organization compared with a Windows 3.x system. After getting used to the new features, I found three different ways to make my Windows 95 machine more like the well-organized Windows 3.1 system it used to be:

1. Drag your old program groups from Explorer onto the desktop, and they will become "windows" of Windows 3.1 fame.
2. Right-click anywhere on the desktop and create a new folder. Name it whatever you like and put all of your shortcuts into it.
3. If you like Program Manager better than Explorer, just change the "shell=Explorer.exe" line in your System.ini file to "shell=Progman.exe". After you reboot, your old Windows 3.1 desktop will reappear right before your eyes! I now have full Windows 95 functionality with the ease of use I enjoyed under Windows 3.1.

CHRIS LUTHY, via the Internet

PC MAGAZINE: We won't argue the relative merits of the Windows 95 and Windows 3.x user interfaces—to each his own! But note that dragging a .GRP file directly onto the desktop or into another folder, as suggested in the first two items above, is not the most efficient path to the desired result of a Windows 3.x look in Windows 95. Every time you double-click on the .GRP file's desktop icon, Explorer will con-

vert it to a submenu of the Start menu and then open the folder representing that submenu. You can make the whole process more efficient by performing that conversion just once. Follow these steps:

1. Navigate to your old Windows directory and launch the .GRP file by double-clicking on it. An Explorer window will appear, showing a new folder in the Windows\Start Menu\Programs folder. The new folder's name will match the window name of the .GRP file, and its items will correspond to the .GRP file's program items. Close this window.
2. Bring up the Start menu and select Programs. Confirm that a new submenu whose name matches the window name of the .GRP file has appeared. Close the Start menu.
3. Right-click on the Start menu button, choose Explore, and navigate to the Programs folder.
4. Locate the new folder in the Programs folder and drag it onto the desktop while holding down the Ctrl key.

You now have a Windows 95 folder on your desktop rather than the .GRP file itself. Conveniently, the folder also appears as a submenu in the Start menu. Note that this technique isn't restricted to menus created by converting .GRP files. You can press Ctrl and drag any submenu from the Start menu to the desktop.

As for using Program Manager in place of Explorer, you don't have to make the commitment right away by changing your System.ini file. Test the waters by simply launching Progman.exe. Figure 1 shows the Windows 95 Program Manager, along with a window full of shortcuts created by processing a .GRP file. The result looks somewhat odd, because the group windows do not minimize to icons, but if a Windows 3.1 look is what you really want, Windows 95 will let you come pretty close.

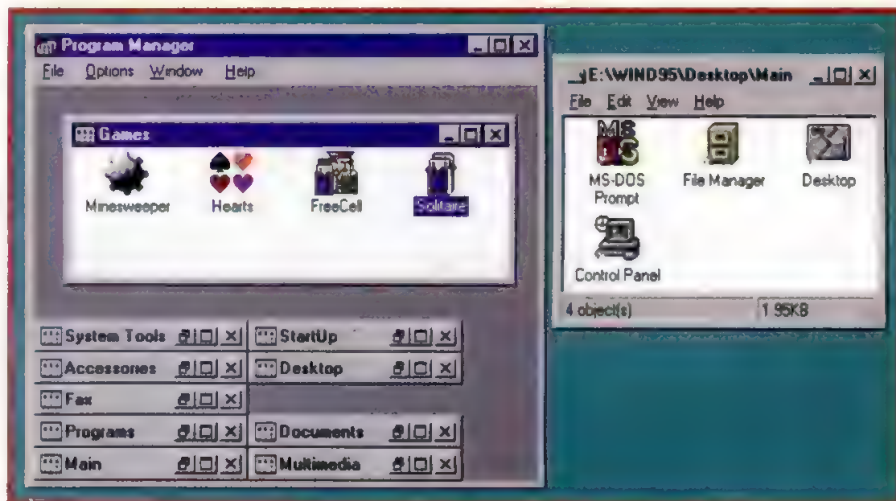


FIGURE 1: When Program Manager runs under Windows 95, group windows minimize to rectangles rather than icons. The window on the right was created by launching the Main.grp file and copying the resulting folder to the desktop.

Ask Our Advisors

HARDWARE

Flipping Floppies



I have an older computer system, and when it boots up, it doesn't check the floppy disk drives. Both drives seem to work fine otherwise, but this behavior has me concerned. Should the boot files on my hard disk become corrupted, how would I be able to boot from a recovery disk in the floppy disk drive? Also, my 3.5-inch disk drive is the B: drive, and I'd like to be able to boot from that. How can I tell my system to check the B: drive when it boots?

DAVID RAINEY,
Concord, California

PC MAGAZINE: There are two steps to solving your problem. First, you need to get your computer to try to boot from the floppy first, and then you need to decide which floppy disk drive it will use.

You should be able to solve the first problem using the computer's own CMOS configuration. Many computer BIOSes now offer advanced settings that allow you to specify the

drive boot sequence. The original IBM AT had only one sequence: Try the A: drive first, then try the C: drive. A more modern BIOS will give you a choice of either "A: then C:" or "C: then A:". Some systems offer a setting of "C: only"—this is handy for security reasons, when you don't want users subverting the security software that's loading from the hard disk or introducing stray operating systems or configuration files.

I suspect that your system has been configured with the "C: then A:" setting. If you leave it alone, you'll still be able to boot from the floppy disk drive if the hard disk fails to boot. Additional advantages to this setting are that your system will boot more quickly if it doesn't have to check the empty disk drive every time and that you are better shielded against boot-sector viruses. But if you prefer, you can change the setting to the more traditional "A: then C:" configuration.

As for booting up from your 3.5-inch drive, you'll need to change the cables inside your system. The only floppy disk drive you can boot from is the A: drive, so you'll need to change the drive assignments. The easiest way to do this is to swap the data connections for

the two floppy disk drives. You'll also have to change your CMOS configuration settings to reflect the swap, so that the A: and B: drives have the correct specifications.—*Alfred Poor*

Memory Matters

I just added another 4MB of memory to my computer for a total of 8MB, but it appears that I'm not getting the full benefit of the upgrade. When I turn on the computer, it shows 8192K as it should, but when I use the mem command, the value for the "largest executable program size" is still 533K, just as it was before I added the extra memory. On the advice of the technician who installed the memory, I ran MEMMAKER, which brought this value up to 551K—not much of an increase. I don't want to think I spent all that money for no noticeable return. How can I utilize my additional memory to improve system performance?

LÁSZLÓ BOCHKOR,
Astoria, New York

PC MAGAZINE: You haven't been duped by the store or the technician; you've just been led astray by an incomplete understanding of how your computer uses its memory. You probably won't see any performance gains for DOS programs, but you should see some

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INDEX

SYSTEMS	COMPUTER/DISCOUNT
Austin Computer Systems.....249	WAREHOUSE.....235
CompuLink Research.....243	First Source International.....269
COMPUTER DISCOUNT	H. Co./Micro Mall.....267
WAREHOUSE.....235	INSIGHT DIRECT, INC.....272
HARTFORD COMPUTER	LA Trade.....278
GROUP.....270	Magix.....244
INSIGHT DIRECT, INC.....272	MEGAHAUS.....233
Magitronic.....255	Micro Solutions.....253
MIDWEST COMPUTER	MIDWEST COMPUTER
WORKS.....256	WORKS.....256
NECX.....281	MIDWEST MEMORY
PCs Compleat.....259	WORKS.....245
USA Flex.....268	PC Connection.....258
SOFTWARE/PERIPHERALS/ COMPONENTS	PC Zone.....246
ARLINGTON COMPUTER	SPSS, Inc.....279
PRODUCTS.....266	

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234 PC MAGAZINE SEPTEMBER 24, 1996

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NoteJet III

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DELL

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ThinkPad 365 series
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ThinkPad 500/510Cs
ThinkPad 701C, 701Cs
ThinkPad 701C, 701Cs
ThinkPad 750
ThinkPad 750
ThinkPad 755
ThinkPad 755
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ThinkPad 755

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16MB	\$212.10	41114
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NEC

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Versa 2000C, D, S
Versa 2000C, D, S
Versa V, Ultralite Versa, Versa 4000
Versa V, Ultralite Versa, Versa 4000
Versa V, Ultralite Versa, Versa 4000
Versa V, Ultralite Versa, Versa 4000
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Versa V, Ultralite Versa, Versa 4000

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Satellite 100CS, 105CS
Portege 610CT
Portege 610CT
Satellite Pro 400
Satellite Pro 400
Satellite Pro 410 series
Satellite Pro 410 series
Satellite Pro 410 series
Tecra 700CS, 700CT
Tecra 700CS, 700CT
Tecra 700CS, 700CT
Tecra 710CDT, 720CDT
Tecra 710CDT, 720CDT
Tecra 710CDT, 720CDT

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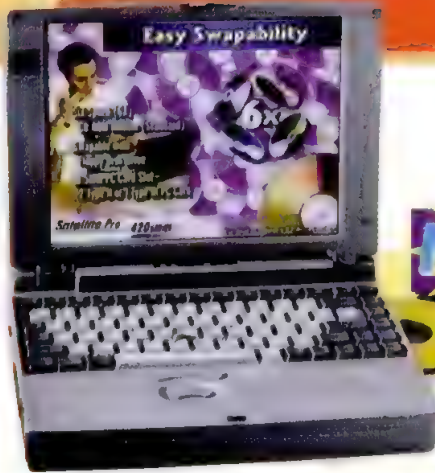
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CDW 70243



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Model	CPU	RAM	Hard Drive	CD-ROM	Price	CDW
P30 CSS11	100MHz	8MB	1.2GB	4X	\$3351.37	65839
P40 CTS11	120MHz	16MB	1GB	6X	\$3287.93	73028
P40 CTS11	120MHz	16MB	2.1GB	6X	\$3749.59	73029
P50 CTS12	133MHz	24MB	1GB	6X	\$4211.73	73030
P50 CTS12	133MHz	24MB	2.1GB	6X	\$4676.95	73032

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9315/9316

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9312	166MHz Pentium	24MB	2.5GB	8X	\$2445.84	71902
9315	166MHz Pentium	32MB	2.5GB	8X	\$2633.64	71903
9316	200MHz Pentium	32MB	3GB	8X	\$2821.44	71905

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Model	CPU	RAM	Hard Drive	CD-ROM Drive	Modem	Price	CDW
9304	133MHz Pentium	24MB	1.6GB	8X	28.8K bps	\$1659.53	71898
9308	166MHz Pentium	24MB	2.5GB	8X	28.8K bps	\$2073.30	71899
9314	200MHz Pentium	24MB	4GB	8X	28.8K bps	\$2633.64	71900

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Monitor sold separately

Model	CPU	RAM	Hard Drive	Price	CDW
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5120/1200	120MHz Pentium	8MB	1.2GB	\$1401.20	72607
5133/2500	133MHz Pentium	16MB	2.5GB	\$1858.85	72613
5166/1200	166MHz Pentium	16MB	1.2GB	\$1966.20	72610
6180/1200/CD	180MHz Pentium Pro	16MB	1.2GB	\$2542.50	72756
6200/2500 CD	200MHz Pentium Pro	16MB	2.5GB	\$3152.70	72762

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Monitor sold separately

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515CCx	120MHz Pentium	16MB	1.28GB	6X	\$1819.73	72890
515CD	133MHz Pentium	16MB	1.62GB	6X	\$1828.93	72891
515MCx	133MHz Pentium	16MB	1.62GB	6X	\$2059.95	72892
515MCx	150MHz Pentium	16MB	1.62GB	6X	\$2169.25	72893
515MCx	166MHz Pentium	16MB	1.62GB	6X	\$2349.03	72894

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10-user to 50-user CD	2377.32
25-user to 50-user CD	1905.09
50-user to 100-user CD	1349.43
50-user to 100-user CD	2107.58
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50-user 3.5"	3231.25

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BayStack 100BASE-T 12-port hub	1556.51



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Token Ring MAU multiport	377.56

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Netelligent 2000 10BT repeater	819.70



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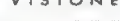
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measurable improvement for Windows applications.

PC memory is generally divided into two areas: the first megabyte, and everything else. The first megabyte is itself divided into two regions: the first 640K that is *conventional memory*, and a reserved area between 640K and 1MB known as *upper memory*. Everything above 1MB is *extended memory* (though some of it can be assigned for use as *expanded memory*—a topic better-suited for another day.)

Though methods were eventually found to access the upper memory area and even beyond, by design DOS programs are essentially restricted to the conventional memory area. That “640K barrier” is fundamental to the way DOS works, and no matter what tricks you use, you’ll never see more than 640K free.

A small portion of DOS and some of your other driver and configuration files have to load into this area. The amount of conventional memory left over is all that you have available to run DOS applications—this is a limitation that has frustrated game players for years, forcing them to create special boot disks and jump through other configuration hoops.

Windows, on the other hand, can use extended memory directly. When it runs in 386 enhanced mode, Windows can create multiple virtual machines within your system—one for each DOS box—and each one with its own 640K to draw on. Furthermore, all Windows programs run in a single virtual machine, and they can draw on as much extended memory as they need.

So, although you won’t see higher numbers for available conventional memory, your additional memory means that Windows does not have to go to its swap file on your hard disk as soon or as often as it might have before the addition of the extra 4MB of memory. This in turn will result in a noticeable performance gain, especially if you are switching back and forth between a couple of Windows programs. If you want to measure this difference, get a copy of the ZD WinBench 96 benchmark test program and run the tests twice—once with your system configured with the original 4MB of memory, and again with the new total of 8MB of memory. And if you’re running Windows 95, you might want to take advantage of the drop in memory prices to double your memory again; 16MB does wonders for Windows 95 performance.—*Alfred Poor*

Font Facts

I am in the market for a new color ink jet printer, but I'm confused by the scalable fonts specification. One printer I like has 14 scalable fonts, while another that costs a bit more has 26 fonts. I plan to use the new printer

under Windows 3.x. If my Windows configuration has more than 14 fonts installed, does this mean that the first printer won't be able to print them all? If not, how can I tell which ones will print?

GARY N. WHITFIELD,
LaGrange, Georgia

PC MAGAZINE: It's easy to get confused by specifications, but in this case, the difference between the number of scalable fonts in these two printers probably isn't enough to affect your purchase decision. The specifications you cite refer to the number of scalable fonts that the printers have in their hardware. These are also sometimes referred to as “resident fonts,” because they are always available in the printer and do not need to be sent by the computer.

If you are running Windows, however, this is not all that important. Although you can speed up a print job by specifying a printer-resident font in your Windows application, most users prefer to use TrueType fonts instead. TrueType fonts give you more choices than you'll find in the resident fonts of most printers, and you'll get more or less the same look when you use TrueType fonts for the same document on different printers.

The downside is that TrueType fonts take a bit longer to print. If your printer can accept downloaded fonts (as can most laser printers and some ink jets), then the printer driver can send each font to the printer once, then just send the text to be printed with that font. This means that after the computer teaches the printer how to make a letter *a*, it does not need to send that picture again the next time your document has an *a* in it.

If the printer can't utilize downloaded fonts (as is the case with many ink jets and impact dot matrix printers), then the TrueType information must be sent as graphics data—as if the computer were sending a tiny picture of each letter each time. This means that it must send the *a* picture every time the letter *a* appears in your document.

Sending this picture to the printer will require several bytes of data, compared with the 1 byte needed to tell the printer to print using a resident font. Printing a document using a downloaded font will also require several bytes of data to download the picture of the letter *a*, but only 1 byte is needed each time the printer has to print another *a* in the document. Generally speaking, therefore, resident fonts print fastest, followed closely by TrueType fonts. If the text must be printed as graphics, printing will take much longer.

Unless this fine point about print speed is an issue for you, Windows users don't need to be overly concerned about the number of resident fonts in their printers.—*Alfred Poor*

OPERATING ENVIRONMENTS

Copy Protection in Windows 95



I recently had to reinstall Windows 95. Before I could do this, I needed the “Certificate of Authenticity” number from the package for the Windows 95 CD-ROM. Of course, I didn't know where it was, so it took the better part of an hour to find it.

I did try to find the file on the CD-ROM itself, using EXTRACT.EXE to search the .CAB files—but to no avail. Is there any way to bypass this new form of copy protection?

MARC KESSLER,
Burlington, Vermont

PC MAGAZINE: Any miscreant who would dare to copy the Windows 95 CD-ROM would surely copy the CD-ROM key number as well. Like most forms of copy protection, it's more of a headache for honest users than for thieves. Do you know where your Windows 95 CD-ROM sleeve is? If you're not absolutely certain, you need to perform the following exercise immediately.

Run the REGEDIT program from the Start menu's Run command, and note the six “root keys” in the left panel. Each key is the root of a tree structure that's very similar to a directory tree. Click the plus sign next to the HKEY_LOCAL_MACHINE key to open it, then open SOFTWARE, Microsoft, and Windows. Click on the CurrentVersion subkey of the Windows key. The right-hand panel will display a large number of values.

Locate the value named ProductID. This value's data is a numeric string with groups of five, three, seven, and five digits, separated by dashes. The three and seven digit groups are the CD-ROM key. For example, if the ProductID data were 12345-678-9012345-67890, this would represent a CD-ROM key of 678-9012345. Write this key down in a safe place, or better yet, in several safe places. It doesn't matter if someone else sees it. But you can't reinstall Windows 95 without it.

—*Neil J. Rubenking*

File Manager Mess

Recently, I've been having a problem with the Windows 3.1 File Manager. Whenever I launch File Manager, I get an error message that says “Unable to read drive A:”. If I click Cancel, the message goes away and File Manager is launched. The only way around this irritating message seems to be putting a disk in the A: drive before launching File Manager. Is there any solution short of reinstalling Windows?

KITAW WOLDESELAASSIE,
Seattle, Washington

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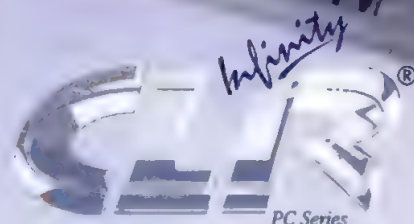


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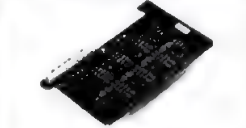
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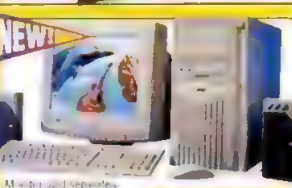
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00234	SyQuest 288MB Removable Cartridge	\$1063 ⁹⁸
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00237	SyQuest 288MB Removable Cartridge	\$1123 ⁹⁸
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00243	SyQuest 288MB Removable Cartridge	\$1243 ⁹⁸
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00245	SyQuest 288MB Removable Cartridge	\$1283 ⁹⁸
00246	SyQuest 288MB Removable Cartridge	\$1303 ⁹⁸
00247	SyQuest 288MB Removable Cartridge	\$1323 ⁹⁸
00248	SyQuest 288MB Removable Cartridge	\$1343 ⁹⁸
00249	SyQuest 288MB Removable Cartridge	\$1363 ⁹⁸
00250	SyQuest 288MB Removable Cartridge	\$1383 ⁹⁸
00251	SyQuest 288MB Removable Cartridge	\$1403 ⁹⁸
00252	SyQuest 288MB Removable Cartridge	\$1423 ⁹⁸
00253	SyQuest 288MB Removable Cartridge	\$1443 ⁹⁸
00254	SyQuest 288MB Removable Cartridge	\$1463 ⁹⁸
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PC MAGAZINE: This is actually quite a common problem. If the Save Settings on Exit item in the Options menu is checked, File Manager will save information about the directory windows that are open. Next time you launch File Manager, it will attempt to open those same windows. Clearly, on your system File Manager is attempting to reopen a directory window on the A: drive.

To fix the problem, start by closing all of File Manager's directory windows. Pull down the Options menu and make sure that Save Settings on Exit is checked. Now exit File Manager. The next time you launch it, the problem should be gone. You may, however, want to remove the check next to Save Settings on Exit to avoid running into the same problem again.—Neil J. Rubenking

Keeping Your Icons Handy

I tend to keep a lot of windows open on my OS/2 desktop. This poses a problem when I want to open something new, because all of

LaunchPad will automatically bring itself to the top level of the desktop whenever it gets covered up so that it will always be visible, no matter how cluttered things get. You can drag all of your favorite icons and drop them on the LaunchPad so you can open them from it directly.

There is another method, though, that doesn't require all of that modification to the LaunchPad. Move the pointer to an empty area of the desktop and click with the right mouse button. From the pop-up menu, click on Settings to open the Settings Notebook for the desktop itself. Now click on the Notebook's Window tab, and look at the bottom of the page for Object Open Behavior. Click on the Create New Window radio button and close the notebook.

You can now create an additional desktop! With the pointer in an empty area of the desktop, click with the right mouse button to bring up the desktop's pop-up menu again. Now click on Open. A new window appears, with all of your desktop icons in it.

Now, when your desktop gets filled with windows and you want to open something else, you can get to your icons without minimizing or closing anything. Just press Ctrl-Esc to open the Window List and double-click on the top Desktop Icon View entry (see Figure 1). That will bring your icon-filled window to the foreground, and you can make your selection.

Unless you have modified the default AUTOSTART values in your CONFIG.SYS file, this extra desktop window will reopen itself automatically

every time you boot Warp—as long as you don't close that desktop before shutting down the system.—Brian Proffitt

WORD PROCESSING

Changing Bullets in Ami Pro 3.1



I use bullets extensively in Ami Pro 3.1, entering them with the Edit | Insert | Bullet command. Occasionally, I need to change one of the bullets throughout a document, but the Edit | Find and Replace command doesn't do the job, and with hundreds of bullets in a long document, changing the bullets manually can be a major chore. Is there

any way to change the bullets as easily as with Find and Replace?

NATHAN R. STRAHL,
Durham, North Carolina

PC MAGAZINE: Actually, you can use Ami Pro's Find and Replace command to replace the bullets, but the technique is anything but obvious, since you can't do it if you open the file as an Ami Pro file. (Please note that none of these comments applies to Lotus Word Pro, the latest incarnation of Ami Pro.)

If you take a file with bullets and look at it with, say, the DOS Edit program (either the one that comes with Windows 95 or the one that comes with earlier versions of DOS), you'll find that the bullets aren't entered as actual characters. Rather, they're entered as codes that Ami Pro interprets as characters. These take the form

<<B<*x>>

where x is one of 17 characters: 0 through 9, open parenthesis [(), asterisk [*], plus sign [+], comma [,], minus sign [-], period [.], or forward slash [/].

If you've opened the file as an Ami Pro file, however, knowing these codes doesn't help at all. If you try typing

<<B<*1>>

it will show as text, not as a bullet. And if you save the file and look at the text with the DOS Edit program, you'll see that Ami Pro entered your effort as

<<B<*1<;>>

Ami Pro adds those extra characters automatically to make sure that when you type a greater-than or less-than sign, you don't accidentally enter a code. Unfortunately, this also keeps you from being able to search for a bullet by typing the code in the Find and Replace dialog box.

The way around this impasse is to open the file in Ami Pro as an ASCII file. The program will then treat the codes as text rather than codes and will let you search for and replace the codes the same way you can search for and replace any other text.

Before you try this trick, be sure to make a copy of the file. If you accidentally open or save the file incorrectly, or if you delete or change some information in the header, you may find that Ami Pro will no longer recognize the file as an Ami Pro file. If that happens, you'll be able to retrieve your text, but you'll lose all of your formatting, including the bullets. Making a copy gives you a file to go back to if something goes wrong.

Once you've copied the file, open one copy as an Ami Pro file, go to the end of the file, and enter in both the bullet to be replaced and

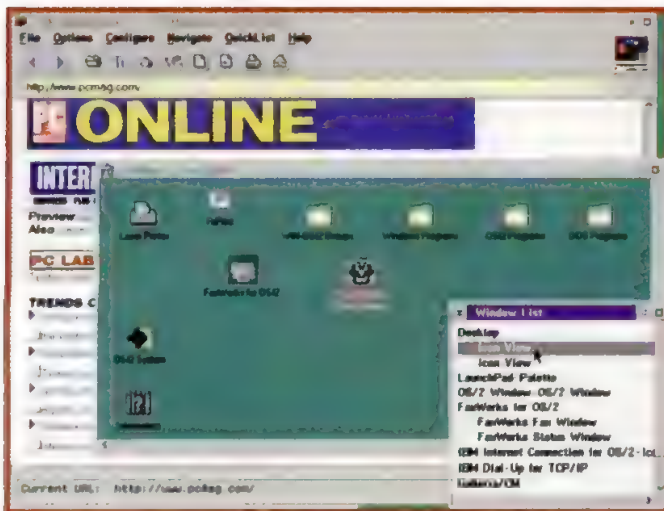


FIGURE 1: An additional desktop keeps your icons handy.

the icons on my desktop are covered up. I hate having to minimize one or more windows just to open something else (and then restore those windows). I really don't want to have to buy an add-on to make this easier. Isn't there something I can do using just OS/2 Warp itself?

GEORGE DENBY,
Hoosick Falls, New York

PC MAGAZINE: There are a couple different approaches to this problem. First, you can use the LaunchPad. Move the pointer to one of the narrow empty places on the LaunchPad and click with the right mouse button. From the pop-up menu, click on Settings to open the Settings Notebook. The first option is Float on Top. If you check this box, the

The Vision

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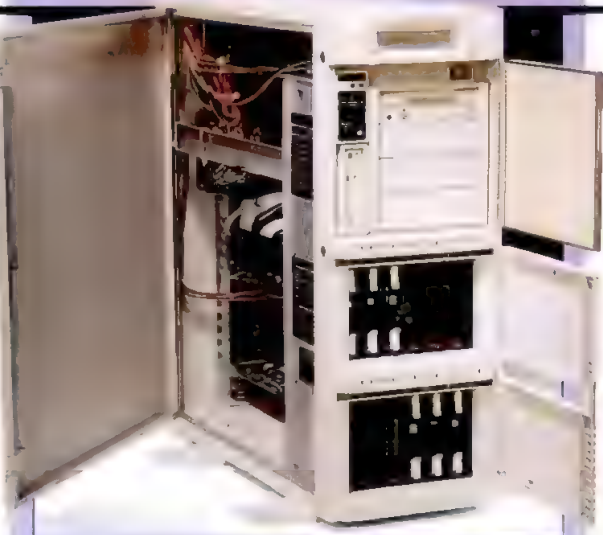
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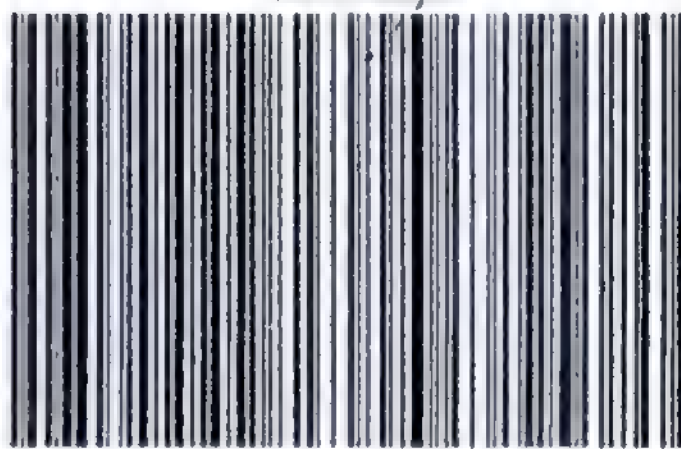
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1. Follow instructions on the other side

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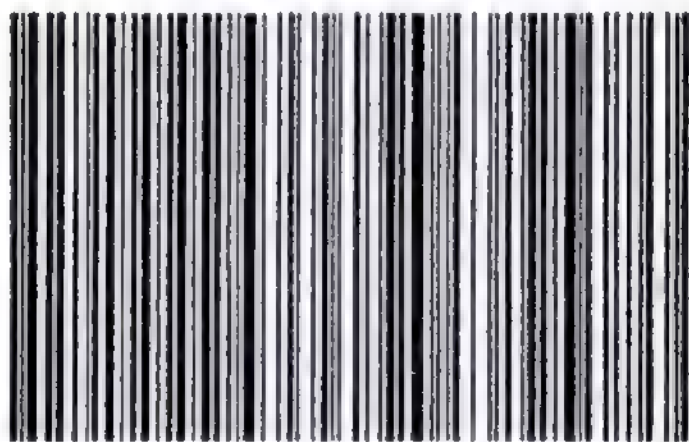
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Inverted Back

1. Follow instructions on the other side

Folded edge of the page

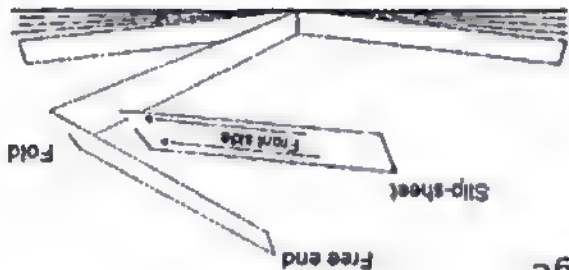


Inverted Foldout slip-sheet

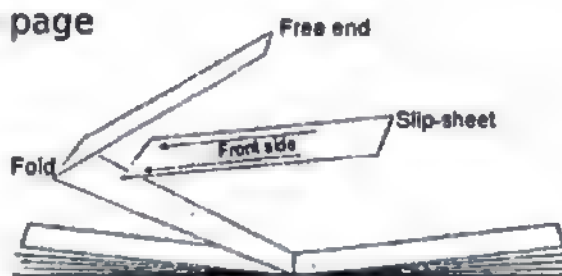
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with

1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



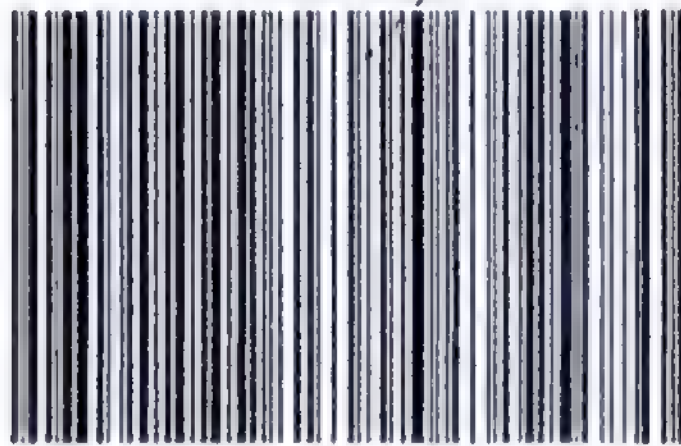
1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Back

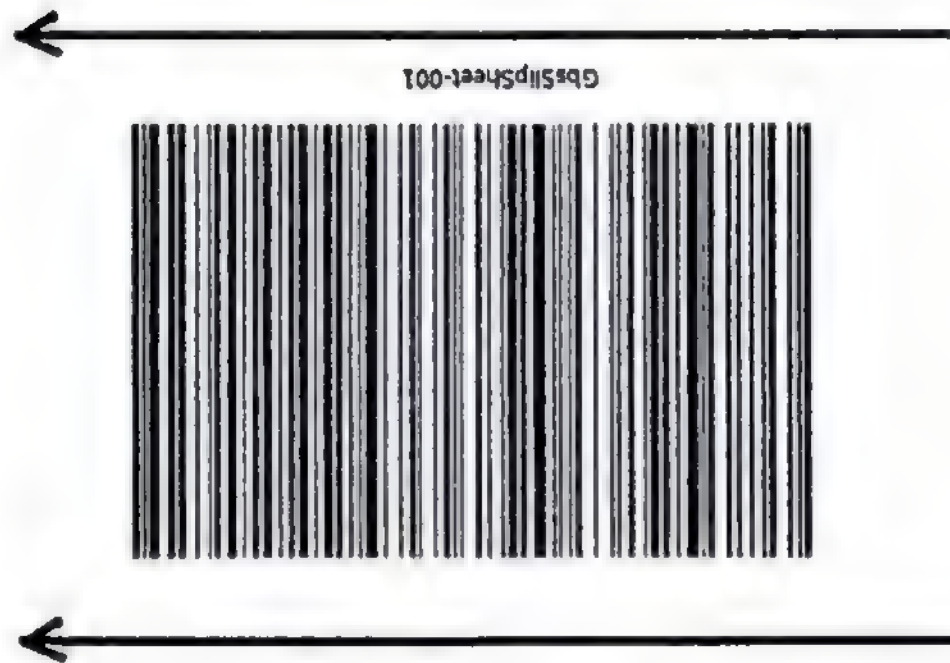
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Inverted Back

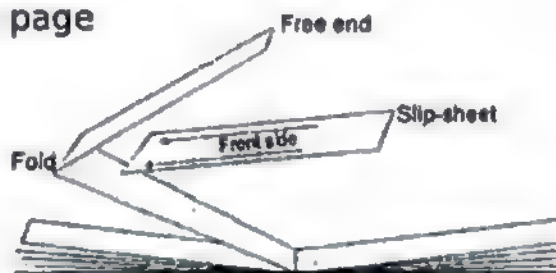
1. Follow instructions on the other side

Folded edge of the page



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
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4. Close the page and slip-sheet

Foldout slip-sheet

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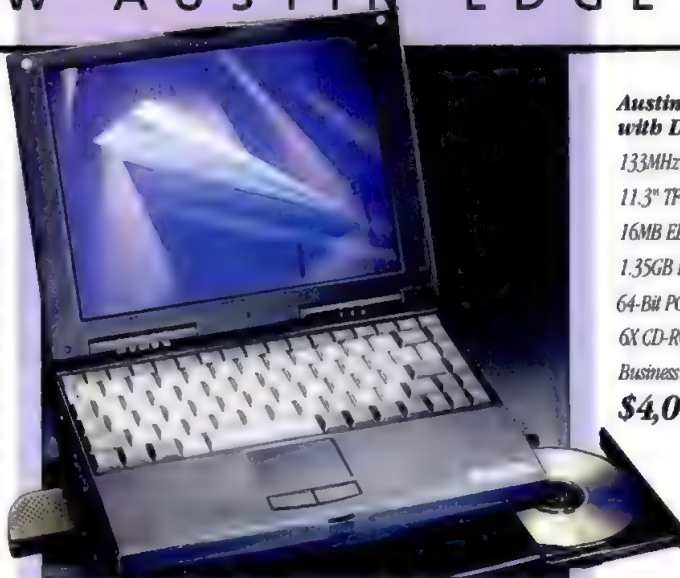
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6X CD-ROM Drive
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Austin Edge CD – 133

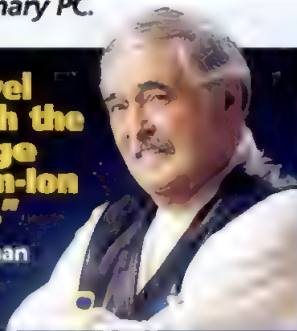
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its replacement. Add some text along with the bullets to label each one clearly. Then you'll know which is which when you reopen the file as an ASCII file and look at the codes themselves.

Close and save the file, then choose File | Open. In the "List files of type" list, choose ASCII, then click on the ASCII Options button. Set the ASCII File Options to "CR/LF at paragraph ends only," and set the ASCII File Type to 7-bit ASCII. Choose OK to close the ASCII Options dialog box, and then select the file you want to open.

When you open the file this way, you'll see header information, with sections in brackets [like this] followed by various entries—much like the Windows WIN.INI or SYSTEM.INI files. You don't normally see any of this, because Ami Pro hides the information from view and uses it for its own purposes. Be careful not to make any changes in this area of the file.

When you remove the shading from a single cell within a block of shaded cells, the gridlines don't reappear around that cell.

Use Ctrl-End to go to the end of the file, and then scroll up, if necessary, to find the labeled codes for the bullet that you want to replace and its replacement. Then choose Edit | Find and Replace, select Options, and make sure the "Beginning of document" check box is checked. Choose OK to close the Find and Replace Options dialog box, enter the appropriate codes in the Find and Replace With text boxes, and use the Find and Replace feature as usual to find and replace the codes. When you finish inserting the new codes, choose File | Save As, and save the file as an ASCII file with the ASCII Options still set for "CR/LF at paragraph ends only," and 7-bit ASCII.

After you save the file, close it and reopen it as an Ami Pro file. Choose File | Open, accept the default Ami Pro setting in the "List files of type" box, and specify the file to open. At this point, if you used the wrong ASCII option settings or accidentally changed some header information, you'll get an error message that tells you this isn't an Ami Pro file. If that happens, delete the modified file and start over with another copy. If the file opens without problems, go to the end of the file and delete the two bullets you added earlier. As a final step, you might want to browse

through the file to confirm that the original bullets were replaced correctly.

—M. David Stone

SPREADSHEETS

Coloring Within the Lines in Excel



I had a project recently in which I created color-coded spreadsheets in Excel 5.0. I discovered some interesting quirks with cell shading that I couldn't figure out. To fill in cells with color, highlight several cells and then choose Cells from the Format menu. Select the Pattern tab in the Format Cells dialog box. Now pick a color from the grid to shade the selected cells. You should see these cells properly shaded.

Now select a single shaded cell and choose Cells from the Format menu. Select the Pattern tab again and click on None from the color grid. Move the highlight away from the single selected cell and observe: There are no lines around the cell! If you go back and remove the shading from all of the original shaded range, you'll see that every cell has the lines around it, as you'd expect. How can I get the gridlines back on a single unshaded cell, and is this process by design?

BILL ANTONACCHIO,
via ZD Net

PC MAGAZINE: In Excel 5.0 as well as Excel 7.0, applying solid shading (or any other pattern) to a cell range eliminates the display of gridlines from that range. When you remove the shading from a single cell within a block of shaded cells, the gridlines don't reappear around that cell, because you've still got shading applied to each adjacent cell.

A gridline is nothing but a light gray cell border, so you can get gridlines to appear around a single unshaded cell within a shaded block by following these steps:

- Remove the shading from the cell.
- Choose Format | Cells again and click the Border tab.
- Select light gray from the drop-down color palette.
- Apply a single solid border to the top, bottom, left, and right sides of the cell.

The same technique, of course, can be used to restore gridlines to a block of shaded cells.

Why does shading trump gridlines? Because most people use shading to make a range of cells stand out in sharp contrast to the surrounding worksheet area. Removing the gridlines assists in that effort. If shading didn't eliminate gridline display, creating a shaded region would, for most users, be a two-step process—one step to apply the color, and a second step to take out the lines.

—Craig Stinson

DATABASES

Creating a Form Without a Menu Bar



Perhaps I'm a stickler for detail, but I consider each of my programs a work of art. When I was creating a demo for one of my applications, I designed a full-screen form in which the user could click on any one of a number of buttons to try different parts of the program. The form looked great, but Access's built-in menus cluttered the screen and served no useful purpose.

Setting the form's Menu Bar property to "0" returned the error message: "Macro '0' not found." So I placed an equal sign before the zero and voilà—no menus! Apparently, the equal sign causes Access to evaluate the expression instead of returning an error message.

So, to blank the menu bar for an Access form, simply put =0 in the form's Menu Bar property.

This routine was tested in Access 2.0.

JOHN RUDSON,
Pickering, Ontario, Canada

PC MAGAZINE: This works in Microsoft Access for Windows 95, too. Note that you can also achieve the same effect by specifying an empty macro (a macro sheet with no macro actions) in the form's Menu Bar property, although typing =0 certainly seems a lot simpler than creating an empty macro.

Keep in mind that if you want *all* of your forms in Access 95 to default to having no menu bar, you can say so in the Startup dialog. Just choose Tools, Startup, and enter =0 in the Menu Bar text box.—Sal Ricciardi

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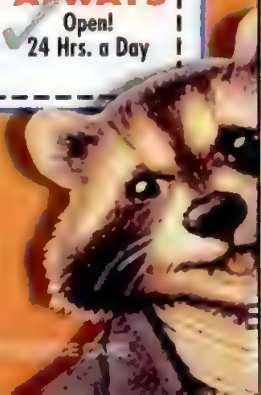
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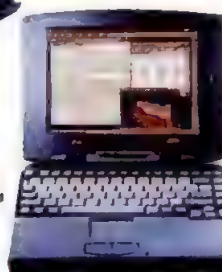
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Pentium 100	12.1" Active SVGA	16MB/1.1GB	\$4999
Pentium 133	12.1" Active SVGA	16MB/1.3GB	5799
Pentium 133	12.1" Active SVGA	16MB/1.4GB	6499

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Processor	Screen	RAM/HD	Price
Pentium 100	10.4" Dual Scan	8/810MB	\$1879
Pentium 100	10.4" Active	8/810MB	2199
Pentium 100	11.3" Dual Scan SVGA	8/810MB	2479*
Pentium 100	11.3" Dual Scan SVGA	8/810MB	2899*
Pentium 120	11.3" Dual Scan SVGA	16MB/1.1GB	2999*
Pentium 120	11.8" Active SVGA	16/810MB	3699*
Pentium 133	11.8" Active SVGA	16MB/1.1GB	4399*

* Features built-in audio
† Includes 4X CD-ROM drive

LTE 5000 Series

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	8/510MB	\$2830
Pentium 75	11.3" Dual Scan	8/810MB	3210
Pentium 75	10.4" Active	8/810MB	3399
Pentium 120	10.4" Active	8MB/1.35GB	4720
Pentium 100	11.3" Dual Scan SVGA	8/810MB	3059
Pentium 120	11.3" Active SVGA	16MB/1.35GB	5099
Pentium 120	10.4" Active SVGA	16/810MB	3999
Pentium 133	12.1" Active SVGA	16MB/1.35GB	5669
Pentium 133	12.1" Active SVGA	16MB/2.2GB	6299



LTE 5000 Series

TEXAS INSTRUMENTS

Extensa 570



Extensa 510/570

- 100MHz Pentium processor
- Built-in 6X CD-ROM drive (570 models only)
- Windows for Workgroups OR Windows 95
- Built-in 16-bit audio, speaker & microphone

Processor	Screen	RAM/HD	Price
Pentium 100	10.4" Dual Scan	8/810MB	\$1769
Pentium 100	11.3" Dual Scan	8/810MB	2249*
Pentium 100	10.4" Active	8MB/1.2GB	2939*

* Features 6X CD-ROM drive

TravelMate 6000

- 120 & 133MHz Pentium processors
- Up to 12.1" Super VGA Active Matrix displays
- Built-in 28.8 fax/modem
- 2MB video memory

Processor	Screen	RAM/HD	Price
Pentium 120	11.3" Active SVGA	8MB/1.08GB	\$4099
Pentium 133	12.1" Active SVGA	16MB/1.35GB	4889



TravelMate 6000

IBM

ThinkPad® 365X/XD

- Pentium 100 & 120MHz processors
- Built-in 4X CD-ROM drive (365XD)
- 10.4" & 11.3" SVGA displays
- 32-bit PCI Local bus graphics
- 16-bit sound, speakers and microphone (365XD)
- Infrared port for wireless communications
- External floppy drive (365XD)

ThinkPad® 365X/XD

Processor	Screen	RAM/HD	Price
Pentium 100	10.4" Dual Scan SVGA	8/810MB	\$2499
Pentium 100	11.3" Dual Scan SVGA	8/810MB	2799*
Pentium 100	11.3" Active SVGA	8/810MB	2899
Pentium 120	11.3" Dual Scan SVGA	8MB/1.1GB	3299*
Pentium 120	11.3" Active SVGA	8MB/1.1GB	3699*

* ThinkPad® includes built-in 4X CD-ROM drive

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- External floppy drive reduces weight
- EDO RAM memory enhances performance
- Infrared transceiver for wireless communication

Processor	Screen	RAM/HD	Price
Pentium 100	11.3" Dual Scan SVGA	8/810MB	\$2699
Pentium 120	12.1" Active SVGA	8/810MB	3749
Pentium 133	12.1" Active SVGA	8MB/1.1GB	4199



ThinkPad® 560

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Processor	Screen	RAM/HD	Price
Pentium 100	10.4" Active SVGA	8/720MB	\$3199
Pentium 100	10.4" Active SVGA	8/720MB	3199*
Pentium 120	11.8" Active SVGA	8MB/1GB	4159
Pentium 120	11.8" Active SVGA	8MB/1GB	4159*

* Features Windows for Workgroups

Hitachi M[™] Series

- Integrated 10-Base-T Ethernet card
- Built-in 28.8 data fax/modem
- SoundBlaster Pro compatible audio
- Built-in 4X and 6X CD-ROM drives

Processor	Screen	RAM/HD	Price
Pentium 100	10.4" Active SVGA	8/720MB	\$3499
Pentium 100	10.4" Active SVGA	8/720MB	3499*
Pentium 120	11.8" Active SVGA	16MB/1GB	4999
Pentium 120	11.8" Active SVGA	16MB/1GB	4999*
Pentium 133	11.8" Active SVGA	16MB/1GB	5499
Pentium 133	11.8" Active SVGA	16MB/1GB	5499*

* Features Windows for Workgroups



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Processor	Screen	RAM/HD	Price
Pentium 100	11.3" Dual Scan SVGA	8/800MB	\$2999
Pentium 100	11.3" Dual Scan SVGA	8MB/1.2GB	3299
Pentium 133	11.3" Active SVGA	8/800MB	3949
Pentium 133	11.3" Active SVGA	8MB/1.2GB	4249

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Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan SVGA	8/500MB	\$1969
Pentium 75	10.4" Dual Scan SVGA	8/800MB	2159
Pentium 100	10.4" Dual Scan SVGA	8/800MB	2349
Pentium 100	10.4" Active Matrix SVGA	8/800MB	2839
Pentium 133	10.4" Active Matrix SVGA	8/800MB	3299



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digital

Digital HiNote VP



Digital HiNote VP

Processor	Screen	RAM/HD	Price
Pentium 100	11.3" Dual Scan SVGA	8/810MB	\$2099
Pentium 100	11.3" Dual Scan SVGA	8/810MB	2099*
Pentium 120	11.3" Dual Scan SVGA	8MB/1GB	2449
Pentium 120	11.3" Dual Scan SVGA	8MB/1GB	2449*
Pentium 120	11.3" Active SVGA	8MB/1GB	2939
Pentium 120	11.3" Active SVGA	8MB/1GB	2939*

* Features Windows for Workgroups

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Processor	Screen	RAM/HD	Price
Pentium 133	11.3" Active SVGA	16MB/1.35GB	\$4499
Pentium 133	11.3" Active SVGA	16MB/1.35GB	4499*
Pentium 133	11.3" Active SVGA	16MB/1.35GB	4699†
Pentium 150	11.3" Active SVGA	16MB/1.44GB	4799
Pentium 150	11.3" Active SVGA	16MB/1.44GB	4799*
Pentium 150	11.3" Active SVGA	16MB/1.44GB	4999†

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* Features Windows for Workgroups
† Features Windows NT

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- Built-in SoundBlaster compatible sound, mic & speakers (selected models)

Processor	Screen	RAM/HD	Price
Pentium 100	11.3" Dual Scan SVGA	8/515MB	\$1999
Pentium 100	11.3" Dual Scan SVGA	16MB/1GB	2299
Pentium 100	11.3" Dual Scan SVGA	8MB/1GB	2499†

Processor	Screen	RAM/HD	Price
Pentium 120	11.3" Active SVGA	8MB/1GB	\$3869*
Pentium 120	11.3" Active SVGA	8MB/1GB	3999†
Pentium 133	11.3" Active SVGA	16MB/1.1GB	3999†
Pentium 133	12.1" Active (SHA)	16MB/1.3GB	4999†
Pentium 133	12.1" Active SVGA (SHA)	16MB/1GB	4999*

* Includes built-in 4X CD-ROM drive
† Includes built-in 6X CD-ROM drive



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HP OmniBook 5000

- Up to Pentium 120MHz with 32-bit PCI Local bus
- 1.2GB drives for high capacity storage
- Super VGA-800x600 resolution
- Built-in 16-bit sound, microphone & speaker

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active SVGA	16MB/1.2GB	\$3929
Pentium 120	10.4" Active SVGA	16MB/1.2GB	\$4259

HP OmniBook 5500

- Up to 133MHz Pentium with 32-bit PCI Local bus
- Super VGA-800x600 resolution on notebook
- PCI Local bus video, 1MB video memory
- 16-bit stereo sound with 2 speakers
- Optional 4X CD-ROM available

Processor	Screen	RAM/HD	Price
Pentium 120	11.3" Dual Scan SVGA	16MB/1.35GB	\$4259
Pentium 120	10.4" Active SVGA	16MB/1.35GB	4489
Pentium 120	12.1" Active SVGA	16MB/1.35GB	5259
Pentium 133	12.1" Active SVGA	16MB/1.35GB	5579
Pentium 133	12.1" Active SVGA	16MB/2GB	5999

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Pentium
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HP OmniBook 5500 Notebook PC

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- 16-bit stereo audio, speakers & microphone
- Optional docking station available

Processor	Screen	RAM/HD	Price
Pentium 100	11.3" Dual Scan SVGA	8MB/1.3GB	\$2499
Pentium 100	10.4" Active SVGA	8MB/1.3GB	3199
Pentium 120	11.3" Active SVGA	8MB/1.3GB	3799
Pentium 133	11.8" Active SVGA	16MB/1.3GB	4799



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- 16-bit stereo sound, headset & mic. on selected models
- 28.8 data/fax/modem with answering machine and speaker phone on select models
- Up to 8X CD-ROM drives on selected models
- EDO RAM memory expandable up to 128MB
- Microsoft Small Business Center models include Office Professional for Win 95 with Bookshelf MS Publisher, MS Plus for Win 95 & MS Network

Additional HP Vectra models available. Call for complete details.

Processor	RAM/HD	CD-ROM	Price
Pentium 100	8MB/1.28GB	4X	\$1289
Pentium 100	8MB/1.28GB	4X	1499
Pentium 120	16MB/1.28GB	6X	1869*
Pentium 133	16MB/1.62GB	6X	2119*
Pentium 150	16MB/1.62GB	6X	2249*
Pentium 166	16MB/2.50GB	8X	2329
Pentium 166	16MB/1.62GB	6X	2429*

* Includes Microsoft Small Business Center

Monitors priced separately

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Product differs slightly from photo

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- 8X CD-ROM drive
- Up to 200MHz Pentium processors
- MPEG Level 1 playback support
- 33.6 data/fax/voice modem on selected models
- Integrated 3-D surround sound
- Video conferencing & tuner card on 9312 model

**UP TO 200MHz
PENTIUM**

Processor	RAM/HD	CD-ROM	Price
Pentium 133	24MB/1.6GB	8X	\$1699*
Pentium 166	24MB/2.5GB	8X	2199*
Pentium 166	24MB/2.5GB	8X	2499*
Pentium 166	24MB/2.5GB	8X	2599†
Pentium 166	32MB/2.5GB	8X	2799
Pentium 200	24MB/4.0GB	8X	2799
Pentium 200	32MB/3.0GB	8X	2999

* Features a 33.6 data/fax/voice modem
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Processor	RAM/HD	CD-ROM	Price
Pentium 120	8MB/1.2GB	4X	\$1560
Pentium 120	16MB/1.6GB	6X	1749
Pentium 133	8MB/1.2GB	6X	1750
Pentium 133	16MB/1.6GB	6X	1849
Pentium 150	8MB/1.2GB	6X	1950
Pentium 150	16MB/2GB	6X	2340
Pentium 166	16MB/2GB	6X	2359

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Processor	RAM/HD	CD-ROM	Price
Pentium 133	16MB/1.6GB	6X	\$1899
Pentium 166	16MB/2.5GB	6X	2399

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Presario Multimedia PC

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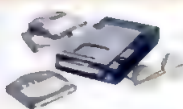
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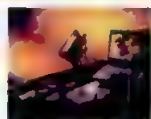
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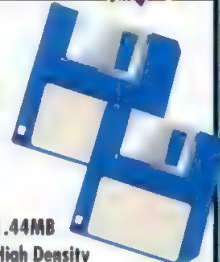
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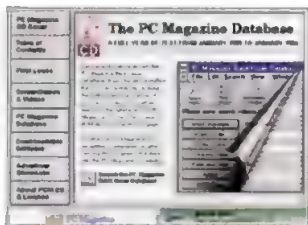
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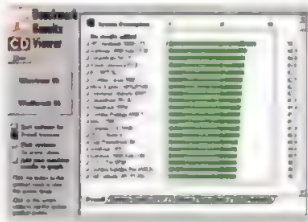
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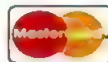
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540MB.....\$549	540MB.....\$549
810MB.....\$729	810MB.....\$649
1.3GB.....\$829	1.3GB.....\$649
	TOSHIBA 4700CT 4800 4850 4900
	810MB.....\$699
	1.3GB.....\$899

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IBM

Advantage Plus 486 DX/33 DX2/50 DX2/66

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8MB MD.....\$99

Advantage Pro 486/33 SX/25 Brevio LC

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8MB MD.....\$99

16MB MD.....\$279

Business 486/33 DX2/50 DX2/66

4MB MD.....\$59

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16MB MD.....\$279

Business 486/33 DX2/50 DX2/66

4MB MD.....\$59

8MB MD.....\$99

16MB MD.....\$279

Business 486/33 DX2/50 DX2/66

4MB MD.....\$59

8MB MD.....\$99

16MB MD.....\$279

Business 486/33 DX2/50 DX2/66

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8MB MD.....\$99

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RAM	4-16	1-189	3248	4-16	23
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Acoustic 800T & 800P Models							
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5400	100	148.00	578	640	50	172.00	170
Acoustic 800T Models							
6400	100	148.00	578	640	50	172.00	170
Acoustic 800P Models							
6400	100	148.00	578	640	50	172.00	170
Acoustic 800T & 800P Models							
6400	100	148.00	578	640	50	172.00	170
5400	100	148.00	578	640	50	172.00	170
Acoustic 800T Models							
6400	100	148.00	578	640	50	172.00	170
5400	100	148.00	578	640	50	172.00	170
Acoustic 800P Models							
6400	100	148.00	578	640	50	172.00	170
5400	100	148.00	578	640	50	172.00	170



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PowerBook 5300 Models					
RAM	At 37501/A	\$102	1.66M	n/a	\$100
2.66M	n/a	---	\$204	3.2M	\$140

DELL

Computer 437 Models					
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6MB	6050070			
Purchasing 340, 360, ICE, CSE, P, PE, 370, 755 Peripherals Modules				
4MB	84055899	560	6MB	84085902
6MB	84055905	5200	72MB	n/a
Purchasing 360, 510, C, D, SE, & 360 F, P, PE Modules				
4MB	02047087	550	6MB	02057090
Purchasing 360, 510, C, & 360 Modules				
6MB	02057180	5100	6MB	02057184

TOSHIBA

Toshiba 1600 Series			
Model	Processor	RAM	Price
1600	PII 400MHz	512	\$199
1600	PII 400MHz	1GB	\$249
Toshiba 1800 Series			
Model	Processor	RAM	Price
1800	PII 500MHz	512	\$299
1800	PII 500MHz	1GB	\$349
Toshiba 2000 Series			
Model	Processor	RAM	Price
2000	PII 600MHz	512	\$399
2000	PII 600MHz	1GB	\$449
Toshiba 2200 Series			
Model	Processor	RAM	Price
2200	PII 700MHz	512	\$499
2200	PII 700MHz	1GB	\$549

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Adaptive 8-Bit/Sec. 232/Sec. 487/Sec. 1440 4-2000 487's Modem		
Adap. 150/Sec. 1	185	2400
		1.34
Adap. 150/Sec. 1	185	2400
		1.34
Adaptive 8-Bit/Sec. 232/Sec. 487/Sec. 1440 4-2000 487's Modem		
Adap. 150/Sec. 1	185	2400
		1.34
Adaptive 8-Bit/Sec. 232/Sec. 487/Sec. 1440 4-2000 487's Modem		
Adap. 150/Sec. 1	185	2400
		1.34

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Apple IIc 500K Models			
Apple IIc	\$ 399.95	\$49	(\$450)
Apple IIc	\$ 399.95		\$7
Apple IIc 1M Models			
Apple IIc	\$299.95	\$32	(\$332)
Apple IIc	\$299.95		\$10
Apple IIc 750, 550 Models			
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Apple IIc	\$299.95		\$10
Apple IIc 1M to 1M Plus Models			
Apple IIc	\$299.95		\$7
Apple IIc	\$299.95		\$10
Apple IIc 1M to 1M Plus Premium Models			
Apple IIc	\$299.95		\$7
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Intel EtherExpress Pro/100B \$207
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 Umax PageOffice \$194
 Nanao Flexscan T217TS \$1,039

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 Citizen PIN50 Portable Printer \$199
 Xircor CC combo Ethernet 28.8 \$126
 Xircor CC combo Ethernet 28.8 \$165

Motorola's Marquis Ethernet 28.8 \$159
 IBM ThinkPad 760CD P/133 \$6,599
 AST Ascentia P50 P/133 \$3,907
 Adaptec SlimSCSI APA1460 \$159

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Bravo MS P133 161 6GB	1,769
Bravo MS P133 161 2GB	1,689
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Bravo MS-T P100 161 2GB	1,705
Bravo MS-T P133 161 2GB	1,815
Bravo MS-T P166 161 2GB	2,144
Bravo MS-T P166 162 6GB 6XCD	2,363
COMPAQ	
2000 P1100 8/630MB	\$1,086
2000 P1133 161 2GB	1,800
2000 P166 161 2GB	\$1,910
4000 P133 161 6GB	1,747
6000 P166 161 6GB CDS	2,766
Prosigna All Models	CALL
Prosigna In Stock	CALL
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Desktop XL P100 161 6GB	2,928
NEC	
PowerMate P100 161 6GB	\$1,553
PowerMate P133 161 6GB CD	1,941
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PowerMate P166 161 6GB	2,130
PowerMate P166 161 6GB CD	2,429

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Back-UPS Pro 280 / 420	149 / 229
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Smart UPS vs 650 / 1000	289 / 409
Smart UPS 700 / 1000	334 / 479
Smart UPS 1400 / 2200	589 / 1,010

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Trakker 350MB	156
Jumbo 350 Int / 1400 Int	60 / 187
PowerTape 2400 2.4GB Int / Ext	340 / 934
PowerTape 4000 4GB Int / Ext	1,036 / 1,212
IOMEGA	
Iomega Dito Easy 800 Int / Ext	\$111 / 141
Iomega Dito Easy 3200 Int / Ext	229 / 289

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Graphics Pro Turbo 2MB ISA / PCI	250 / 256
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Graphics Pro Turbo 4MB PCI	395
matrox	
Matrix MGA Millennium PCI 2MB VRAM	\$243 / 364
Matrix Millennium ModVideo Capture Board	211

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Edge 3D 2200XL 2MB PCI	189
Edge 3D 3240XL 2MB PCI	216
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1765GMA 17"	633
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DX1595 15"	361
DX1795 17"	620
DX15T 15"	369
DX17T 17"	725
MAGNAVOX	
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CM2099 14" 1024x768	239
CM4018 17" 1280x1024	610
20CM64 20" 1280x1024	921
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NANAO	
F2-15 15"	\$585
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T2-17S 17"	1,039
T2-17 17"	1,047
F2-21 21"	1,802

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AC31600 1.6GB	237
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WinWriter 150c	272
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ML320 / 321	\$322 / 461
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ML590 / 591	448 / 608
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6X Ext	329
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6x Int Wave Table IO	230
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28.8 Online Express Int	117
28.8 LocalModem Ext	185
V34 28.8 w/Fax Int / Ext	130 / 165
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SoundExpression 28.8 SRP Voice	251

Hayes	
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Accura 28.8 Int / Ext	149 / 170
Accura 14.4 Int / Ext	78 / 86
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BitSURFR ISDN Ext Async	\$334
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ProClass V34 14.4 Int / Ext	119 / 135
ProClass V34 28.8 Int / Ext	177 / 271

US Robotics	
Sportster Voice 28.8 Int / Ext	\$161 / 187
Sportster Winmodem 28.8 Int	107
Sportster V1 28.8 OSVD Int	160
Sportster V1 28.8 Int	293
Sportster V1 28.8 Int / Ext	106 / 186
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Courier V-Everything 28.8 Int / Ext	234 / 288
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28.8 Ethernet Modem w/ack 10Base-T	291
28.8 Ethernet Modem w/ack Combo	311
28.8 Ethernet Modem 10Base-T	365
Ethernet Adapter w/ack 10Base-T	111
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MicroSolutions

Backpack 4x w/out sound	\$ 206
Backpack 4x w/sound	297
Backpack 6x w/out sound	297
Backpack 6x w/sound	349
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NetSurfer 28.8	211
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PS-CT216CTP	346
CNV	288

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3C509B TPO 5pk 20pk	94 421 1,446
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16/10com 5pk	115 547

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MCA 10BT	164

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NetportExpress

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XL Ethernet	430

NOVELL

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CD w/1.25 / 50 / 100 user	1,738 2,642 3,551
3.5" v3 12.5 / 10 user	568 1,369
3.5" v3 12.25 / 50 user	1,739 2,642
3.5" v3 12.100 / 250 user	3,551 5,057

SMC

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EtherPower 10/10BT PC 5pk	138 647
EtherPower 10BT PCI 5pk	115 517
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P30 P100 8500MB Dual 11.3"	3,271
P50 P133 8500MB TFT 11.3"	4,205

COMPAQ

Armada 4130T P133 16.1 58MB 11.8 TFT	\$ 4,285
Armada 1120 P100 8500MB 10.4 STN	1,832
Armada 1120T P100 8500MB 10.4 TFT	2,143
Armada 4110C P100 8500MB CD 11.3 STN	2,795
Armada 4120T P120 16.1 36GB 11.8 TFT	3,634
LTE 520C P120 16.1 35GB 11.3 TFT	5,999
LTE 530C P133 16.1 35GB 12.1 TFT	5,699

IBM

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365XD P100 8500MB 10.4" Dual 4x NEW	2,155
365X P100 8500MB 10.4" Dual NEW	1,819
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365XD P120 8.1 08GB 10.4" TFT 4x NEW	2,836
365XD P120 8.1 08GB 11.3" Dual 4x NEW	2,456
560 P120 8500MB 11.3" Dual NEW	2,599
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NEC

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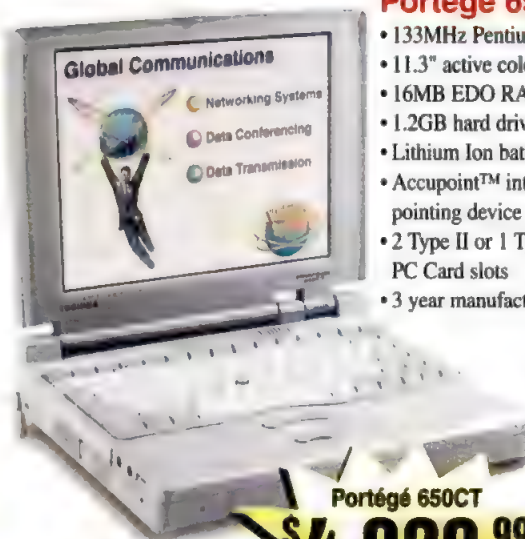
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Model	Processor	Screen	RAM/HDD	CD-ROM	Product Code	Price
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100CS	NEW! 100MHz Pentium®	11.3" Dual Scan Color	8MB EDO/810MB	—	TA110CS	2,269.99
100CT	100MHz Pentium®	11.3" Active Color	8MB EDO/810MB	—	TA110CT	2,759.99
400CS	75MHz Pentium®	10.4" Dual Scan Color	8MB/772MB	—	MAT400CS7	2,199.99
410CS	90MHz Pentium®	11.3" Dual Scan Color	8MB/772MB	—	TA410CS7	2,699.99
420CDS	100MHz Pentium®	11.3" Dual Scan Color	8MB EDO/810MB	6X	TA420CDS	2,869.99
420CDT	100MHz Pentium®	11.3" Active Color	8MB EDO/1.2GB	6X	TA420CDT	3,739.99
500CS	NEW! 120MHz Pentium®	12.1" Dual Scan Color	16MB EDO/1.2GB	6X	TA500CS	3,839.99
500CDT	NEW! 120MHz Pentium®	12.1" Active Color	16MB EDO/1.2GB	6X	TA500CDT	4,929.99
610CT	NEW! 90MHz Pentium®	9.5" Active Color	8MB/686MB	—	TA610CT6	3,059.99
650CT	NEW! 133MHz Pentium®	11.3" Active Color	16MB EDO/1.2GB	—	TA650CT	4,929.99
700CS	120MHz Pentium®	11.3" Dual Scan Color	8MB/1.13GB	—	TA700CS	3,969.99
720	133MHz Pentium®	12.1" Active Color	16MB EDO/1.2GB	6X	TA720CT	6,099.99

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DockMate	TEXTEDDOCK	259.99
DockMate Plus	TEXTZPLU2	589.99
DockMate Net Ready	TEXTNET500	379.99

Texas Instruments Notebook Models

Model	Processor	Screen	RAM/HDD	CD-ROM	Product Code	Price
TravelMate 6020	120MHz Pentium®	11.3" Active Color SVGA	8MB/1.08GB	Optional	TEXT6020	\$4,125.99
TravelMate 6030	133MHz Pentium®	12.1" Active Color SVGA	16MB/1.35GB	Optional	TEXT6030	4,899.99
Extensa 510	100MHz Pentium®	10.4" Dual Scan Color SVGA	8MB/810MB	—	TEXT510	1,769.99
Extensa 570CD	100MHz Pentium®	11.3" Dual Scan Color SVGA	8MB/810MB	6X w/sound	TEXT570CD	2,259.99
Extensa 570CDT	100MHz Pentium®	10.4" Active Color SVGA	8MB/1.2GB	6X w/sound	TEXT57ACDT	2,945.99

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- Integrated 6X CD-ROM drive (optional)
- 2MB VRAM
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- PC Card slot with Zoomed Video support
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- Lithium Ion battery
- 3 year manufacturer's warranty

AST Ascentia J Series Notebooks

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75MHz Pentium®	10.4" Dual Scan SVGA	8MB/800MB	501788-401	2,159.99
100MHz Pentium®	10.4" Dual Scan SVGA	8MB/800MB	501945-401	2,355.99
100MHz Pentium®	10.4" Active Color SVGA	8MB/800MB	501946-401	2,845.99
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AST Ascentia P Series Notebooks

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100MHz Pentium®	11.3" Dual Scan SVGA	8MB/1.2GB	501996-401	3,789.99
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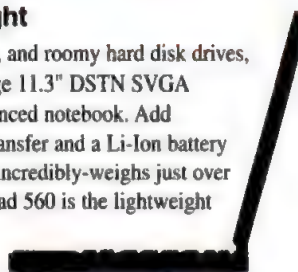
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Model	Processor	Screen	RAM/HDD	CD-ROM	Product Code	Price
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ThinkPad 365ED	5x86 100MHz	10.4" Dual Scan	8MB/540MB	4X CD	IBT2625W9G	2,499.99
ThinkPad 365X	100MHz Pentium®	10.4" Dual Scan	8MB/810MB	—	IBT26256E7	2,499.99
ThinkPad 365XD	100MHz Pentium®	10.4" Dual Scan	8MB/810MB	4X CD	IBT26256E3	2,799.99
ThinkPad 365X	100MHz Pentium®	10.4" Active Color	8MB/810MB	—	IBT26257E7	2,899.99
ThinkPad 365XD	120MHz Pentium®	11.3" Dual Scan	8MB/1.08GB	4X CD	IBT2625EEF	3,299.99
ThinkPad 365XD	120MHz Pentium®	10.4" Active Color	8MB/1.08GB	4X CD	IBT2625DEF	3,699.99
ThinkPad 760LEL	100MHz Pentium®	11.3" Dual Scan	8MB/810MB	—	IBT9547U6G	3,399.99
ThinkPad 760ELD	100MHz Pentium®	12.1" Active Color	8MB/810MB	4X CD	IBT9547U3F	4,499.99
ThinkPad 760LEL	120MHz Pentium®	11.3" Dual Scan	8MB/810MB	—	IBT9547U6F	3,599.99
ThinkPad 760LEL	120MHz Pentium®	12.1" Active Color	8MB/1.08GB	—	IBT9547U4F	4,799.99
ThinkPad 760E	120MHz Pentium®	12.1" Active Color	8MB/810MB	—	IBT9546U4B	4,999.99
ThinkPad 760E	120MHz Pentium®	12.1" Active Color	8MB/1.2GB	—	IBT9546U3B	5,199.99
ThinkPad 760E	133MHz Pentium®	12.1" Active Color	16MB/1.08GB	—	IBT9546U4A	5,999.99
ThinkPad 760E	133MHz Pentium®	12.1" Active Color	16MB/1.2GB	—	IBT9546U3A	6,999.99
ThinkPad 560	100MHz Pentium®	11.3" Dual Scan	8MB/810MB	—	IBT2640S0A	2,699.99
ThinkPad 560	120MHz Pentium®	12.1" Active Color	8MB/810MB	—	IBT2640E0A	3,749.99
ThinkPad 560	133MHz Pentium®	12.1" Active Color	8MB/1.08GB	—	IBT2640F0E	4,199.99

- Pentium® 100MHz processor
- 11.3" DSTN dual scan color display
- 8MB RAM expandable to 40MB
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- 2 Type II or 1 Type III PC Card slots
- Weighs 4.1 lbs. and measures 1.2"



U.S. Robotics®

Sportster Winmodem

The affordable, easy to use faxmodem made especially for Windows-based computers

No more complicated installation manuals, no more dipswitches or strange combinations of keystrokes! Just put Sportster Winmodem into your PC, and it's ready to take you anywhere you want to go online. The Windows operating systems on your computer does all the installation chores for you. To send and receive electronic messages of all kinds, just point and click—it's easier than dialing the phone.



U.S. Robotics Modems

Description	Type	Dst/Fax Rate	Product Code	Price
Sportster Models				
Sportster WinModem 33.6	Internal	33.6/14.4	MBUSR1125	\$109.99
Sportster "Classic" 33.6	Internal	33.6/14.4	MBUSRSP34I	149.99
Sportster "Classic" 33.6	External	33.6/14.4	MBUSRSP34E	169.99
Sportster Voice 33.6	Internal	33.6/14.4	MBUSR1171	169.99
Sportster Voice 33.6	External	33.6/14.4	MBUSR1172	189.99
Sportster Vi 33.6, DSVD	Internal	33.6/14.4	MBUSRV128D	229.99
Courier Models				
Courier V. Everything	Internal	33.6/14.4	MBUSR1223	249.99
Courier V. Everything	External	33.6/14.4	MBUSR1224	289.99

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Toshiba						
Satellite Pro 400, 100	KTT400/8	\$179.99	KTT400/16	\$329.99	KTT400/32	\$629.99
Tora 700 CS, CT	KTT700/8	139.99	KTT700/16	249.99	KTT700/32	479.99
Portege 610CT, 410, 710, 720	KTT610/8	179.99	KTSP16MB	329.99	KTT610/32	629.99
Tora 500 & Portege 650CT	KTT650/8	159.99	KTT650/16	299.99	KTT500/32	599.99
AST Ascentia						
J10, J30, J50	KTASTJ8	189.99	KTASTJ16	369.99	KTASTJ32	699.99
P Series	KTASTP8	159.99	KTASTP16	239.99	—	—
IBM Thinkpad						
365 Series	—	—	KTM356/16	399.99	—	—
760 C, CD, L, LD	KTN760/8	209.99	KTN760/16	409.99	KTN760/32	1,399.99
701C	KT353056	189.99	KT353057	399.99	KT727444	1,399.99
760 E, EL, ED, ELD	KT760E/8	209.99	KT760E/16	409.99	—	—
Travelmate						
Travelmate 5000, 5100, 5200	KT277787	199.99	KT277786	379.99	—	—
Extensa 550, 560, 570	KT1550/8	189.99	KT1550/16	369.99	KT1550/32	699.99
Travelmate 5300	KT15300/8	209.99	KT15300/16	399.99	—	—

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1050MB	Seagate	Hawk 2XL	Ultra Wide SCSI	ST31055W	389.99
2100MB	Micropolis	Aries	Fast SCSI-2	MC4421S	449.99
2100MB	Micropolis	Taurus	Fast SCSI-2	MC4221S	549.99
2100MB	Micropolis	Taurus	Fast Wide SCSI-2 A/V	MC4221AVW	749.99
2100MB	IBM	Ultrastar	Fast SCSI-2	IB94G3054	1,049.99
2100MB	IBM	Ultrastar	Fast Wide SCSI-2	IB94G3055	1,049.99
2147MB	Seagate	Barracuda 2LP	Fast SCSI-2 A/V	ST32550N	749.99
2147MB	Seagate	Barracuda 2LP	Fast Wide SCSI-2 A/V	ST32550W	799.99
2149MB	Seagate	Hawk 2XL	Ultra SCSI	ST32155N	599.99
2149MB	Seagate	Hawk 2XL	Ultra Wide SCSI	ST32155W	639.99
2149MB	Seagate	Hawk 2XL	Ultra Wide SCSI SCA	ST32155WC	639.99
2150MB	Quantum	Atlas	Fast Wide SCSI-2	QUXP3125W	719.99
2150MB	Seagate	Barracuda 4LP	Ultra SCSI	ST32171N	CALL
2150MB	Seagate	Barracuda 4LP	Ultra Wide SCSI	ST32171W	CALL
2160MB	IBM	Ultrastar ES	Fast SCSI-2	IB07H1124	549.99
2160MB	IBM	Ultrastar ES	Ultra SCSI	IB07H1126	559.99
2160MB	IBM	Ultrastar ES	Ultra Wide SCSI	IB07H1128	579.99
4294MB	Seagate	Hawk 4	Fast SCSI-2 A/V	ST15230N	949.99
4294MB	Seagate	Hawk 4	Fast Wide SCSI-2 A/V	ST15230W	989.99
4294MB	Seagate	Barracuda 4	Fast SCSI-2 A/V	ST15150N	1,049.99
4294MB	Seagate	Barracuda 4	Fast Wide SCSI A/V	ST15150W	1,104.99
4294MB	Seagate	Barracuda 4	Fast Wide SCSI-2/SCA	ST15150WC	1,104.99
4300MB	Micropolis	Capricorn	Fast SCSI-2	MC3243S	899.99
4300MB	Quantum	Atlas	Fast SCSI-2	QUXP3430S	989.99
4300MB	Quantum	Atlas	Fast Wide SCSI-2	QUXP3430W	999.99
4300MB	Micropolis	Capricorn	Fast Wide SCSI-2 A/V	MC3243AVW	1,099.99
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4500MB	IBM	Ultrastar/XP	Fast Wide SCSI-2	IB94G3057	1,399.99
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9090MB	Seagate	Elite 9	Fast SCSI-2 A/V	ST410800N	2,099.99
9090MB	Seagate	Elite 9	Fast Wide SCSI A/V	ST410800W	2,154.99
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9100MB	Micropolis	Scorpio	Fast SCSI-2	MC1991	1,799.99
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631MB	Seagate	Medalist XE	Fast-ATA	ST3630A	159.99
810MB	Seagate	Marathon	Fast-ATA-2	ST9816AG	349.99
810MB	Toshiba	Slimline	Fast-ATA	MK1926FCV	329.99
850MB	Seagate	Medalist 850	Fast-ATA-2	ST3850A	169.99
850MB	Western Digital	Caviar	Enhanced IDE	WD2850A	179.99
850MB	Quantum	Trailblazer	Fast-ATA-2	QUTR850A	185.99
1050MB	Western Digital	Hawk 2XL	Ultra SCSI	ST31055N	349.99
1080MB	Western Digital	Caviar	Enhanced IDE	WD21000A	199.99
1082MB	Seagate	ST31081A	Fast-ATA-2	ST31081A	185.99
1090MB	Fujitsu	Winchester	Fast-ATA-2	FJ1614A	179.99
1275MB	Seagate	ST31276A	Fast-ATA-2	ST31276A	195.99
1280MB	Western Digital	Caviar	Enhanced IDE	WD21200A	209.99
1280MB	Quantum	Fireball	Fast-ATA-2	QUFB1280A	219.99
1282MB	Seagate	Medalist SL	Fast-ATA-2	ST51270A	199.99
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1300MB	Toshiba	Slimline	Fast-ATA	MK1301MAV	549.99
1300MB	Toshiba	Notebook	Fast-ATA	MK2720FC	559.99
1336MB	Maxtor	Durango	Enhanced IDE	MX71336A	209.99
1620MB	Western Digital	Caviar	Enhanced IDE	WD31600A	229.99
1623MB	Seagate	ST31621A	Fast-ATA-2	ST31621A	219.99
1670MB	Maxtor	Durango	Enhanced IDE	MX71626A	235.99
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2113MB	Seagate	Medalist	Fast-ATA-2	ST32140A	279.99
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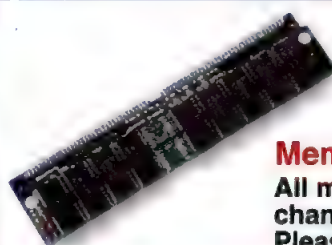
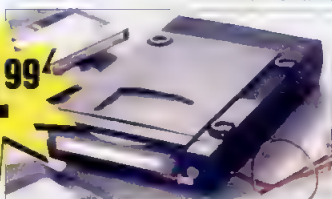
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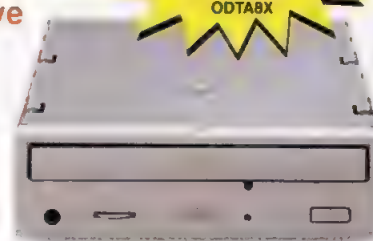


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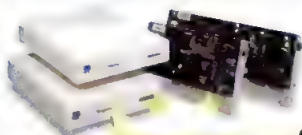
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New Media 14.4/14.4 Faxmodem NMCD0408	65.99
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486 (3.3V)	15.00	15.00	15.00	15.00
486 (3.3V)	15.00	15.00	15.00	15.00
486 (3.3V)	15.00	15.00	15.00	15.00
486 (3.3V)	15.00	15.00	15.00	15.00
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386 (3.3V)	14.99	14.99	14.99	14.99
486	11.00	11.00	11.00	11.00
486 (3.3V)	15.00	15.00	15.00	15.00
486 (3.3V)	15.00	15.00	15.00	15.00
486 (3.3V)	15.00	15.00	15.00	15.00
486 (3.3V)	15.00	15.00	15.00	15.00
486 (3.3V)	15.00	15.00	15.00	15.00
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4425008, 32Meg	4425008, 32Meg	39.00
4425008, 64Meg	4425008, 64Meg	39.00
4425008, 128Meg	4425008, 128Meg	39.00
4425008, 256Meg	4425008, 256Meg	39.00
4425008, 512Meg	4425008, 512Meg	39.00
4425008, 1024Meg	4425008, 1024Meg	39.00
4425008, 2048Meg	4425008, 2048Meg	39.00
4425008, 4096Meg	4425008, 4096Meg	39.00
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7 secrets you need to know about your data

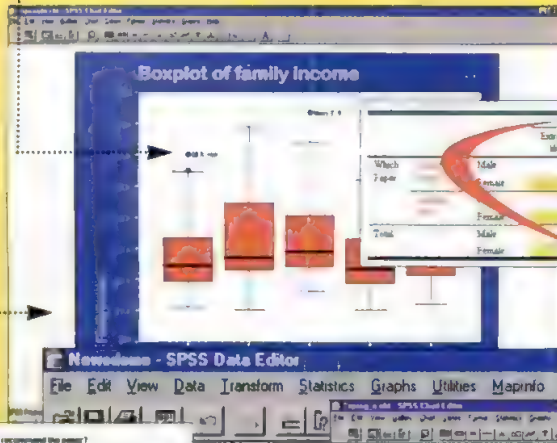
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Chi-Square Tests

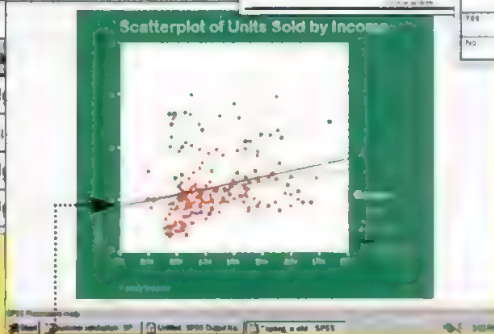
	Value	df	Asymptotic Significance (2-sided)
Yates	10.821	1	.001
Continuity	10.8	1	.001
Exact	11.000	1	.001
Linear by Linear	5.4	1	.020

7 You need accurate results even when some of the data are missing. When there's data missing, or when you enter a code for a "don't know" answer, SPSS can adjust calculations accordingly.

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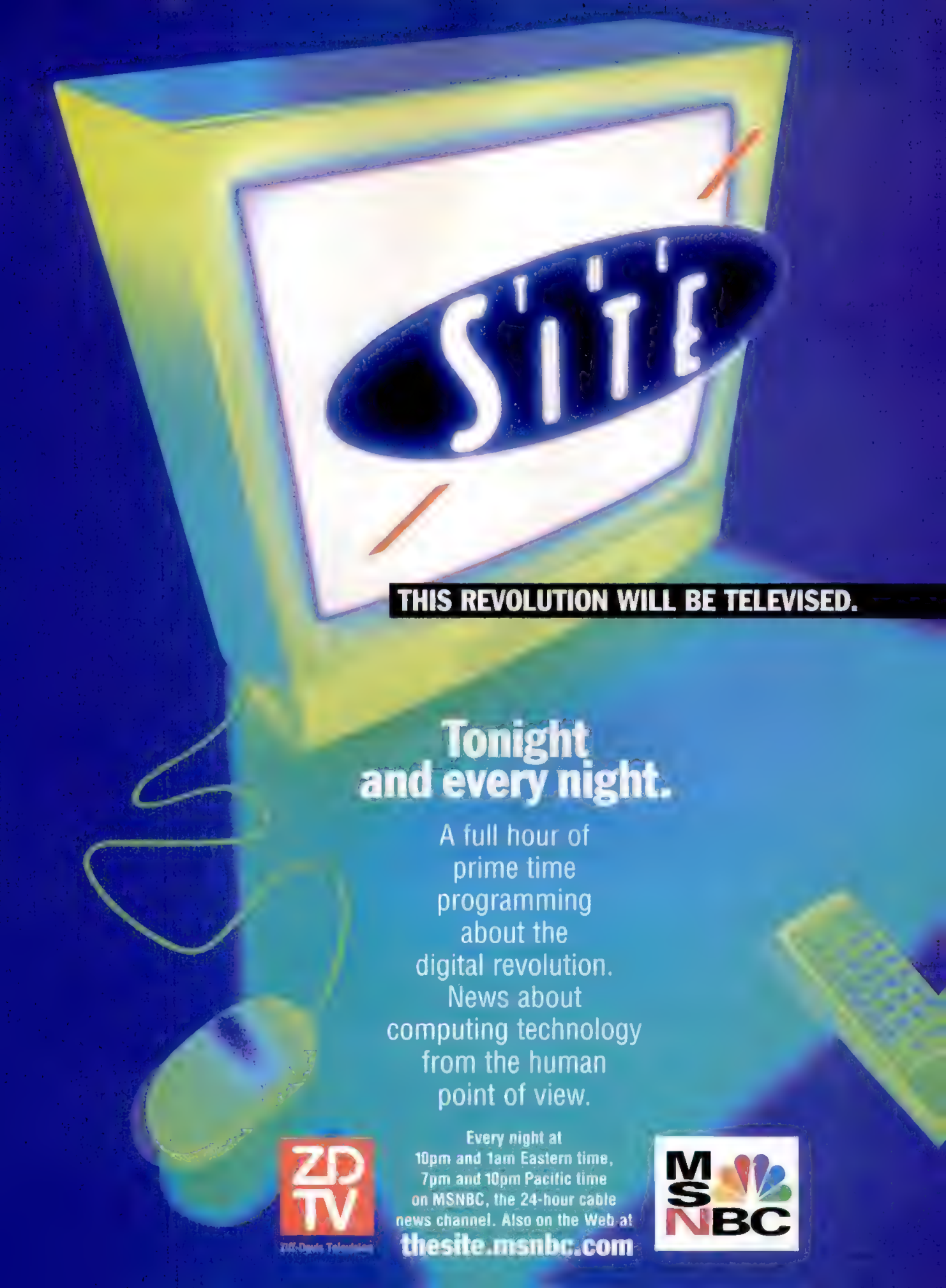
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A computer monitor with a yellow frame is the central focus. On its screen, the word "SITE" is written in a large, white, stylized font inside a dark blue oval. Two red diagonal lines are drawn on the screen, one above and one below the oval. Below the monitor, a yellow computer mouse is visible. To the right, a silver remote control is partially shown. The background is a solid blue color.

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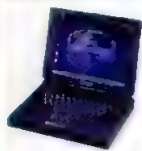


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Video.....	295	
Windows.....		311

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Windows.....	
Adult.....	315
SERVICES	
Computer Insurance.....	311
Data Conversion/Data Recovery.....	312
Desktop Publishing.....	
On-Line.....	299
Scanning Services.....	312
Software Duplication.....	311
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MISCELLANEOUS	
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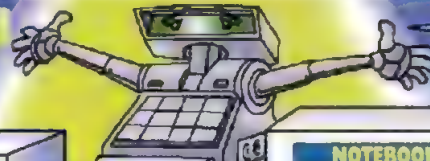
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16 meg 436/32	153/184	153/184	165/130	
32 meg 836/32			319/285	
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Canon AL1000, 1300	84	108			
HP 8, 10, 11, 12	69	115			
HP 8, 10	69	115			
HP 351, 4, 4M, 451		60	119	218	418
HP 1000C, D1000-750		60	119	218	418
HP 4MB, 40, 45, 46M, 4V		50	99	198	398
HP 4MB, 5MB, 55, 55, 55, 55		50	99	198	398
HP 4L (1MB)	47				
HP D1 500 Series (256K)	34				
HP 5L		100	199		
Panasonic 4410, 4430	88	169			
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TI ML, XL (1MB)	45				

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AST models	99	100	200	405
external models	99	100	200	405
4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, 131072, 262144, 524288, 1048576, 2097152, 4194304, 8388608, 16777216, 33554432, 67108864, 134217728, 268435456, 536870912, 1073741824, 2147483648, 4294967296, 8589934592, 17179869184, 34359738368, 68719476736, 137438953472, 274877906944, 549755813888, 1099511627776, 2199023255552, 4398046511104, 8796093022208, 17592186044416, 35184372088832, 70368744177664, 140737488355328, 281474976710656, 562949953421312, 1125899906842624, 2251799813685248, 4503599627370496, 9007199254740992, 18014398509481984, 36028797018963968, 72057594037927936, 144115188075855872, 288230376151711744, 576460752303423488, 1152921504606846976, 2305843009213693952, 4611686018427387904, 9223372036854775808, 18446744073709551616, 36893488147419103232, 73786976294838206464, 147573952589676412928, 295147905179352825856, 590295810358705651712, 1180591620717411303424, 2361183241434822606848, 4722366482869645213696, 9444732965739290427392, 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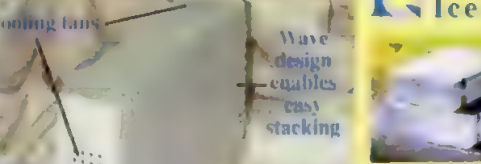


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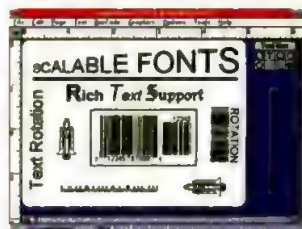
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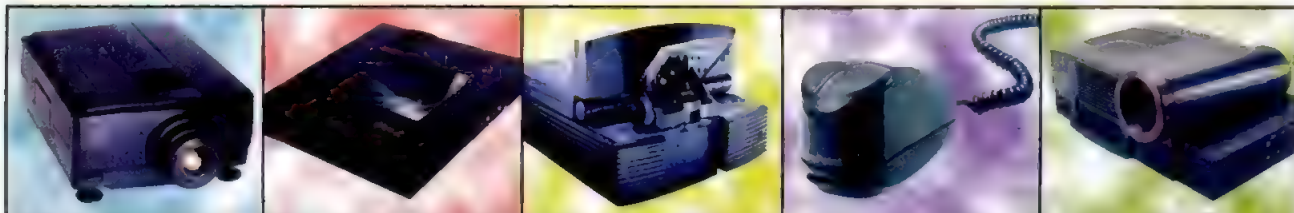
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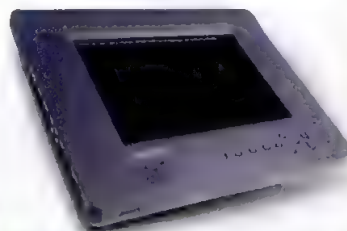
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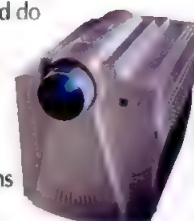
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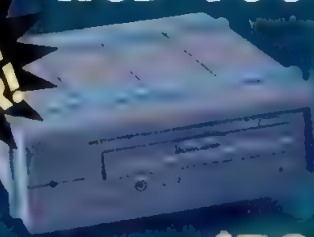
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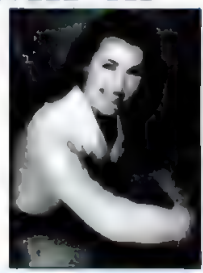
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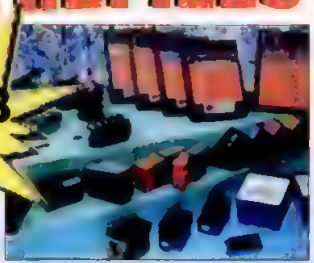
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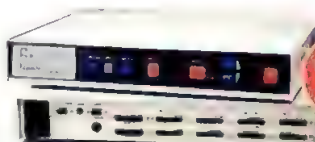
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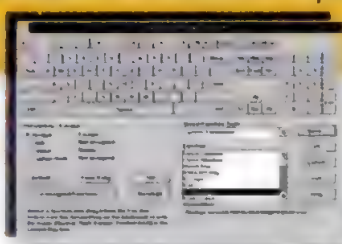
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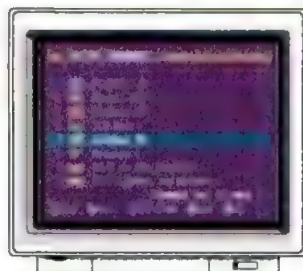
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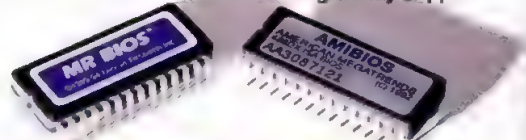
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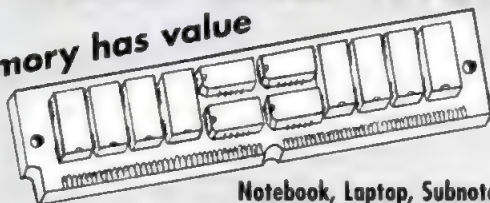
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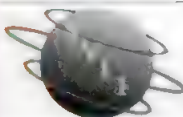
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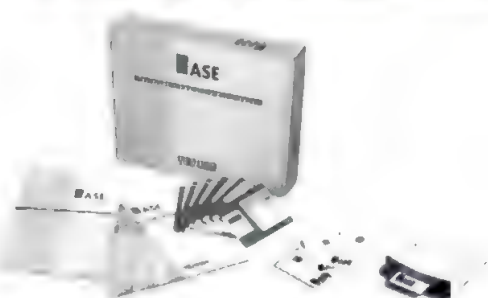
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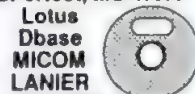
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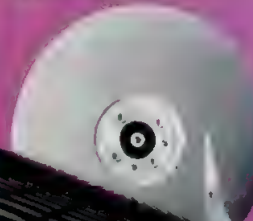
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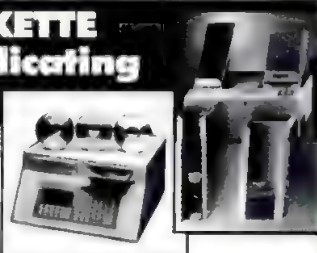
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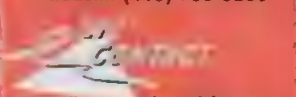
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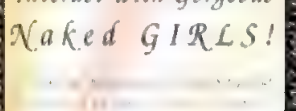
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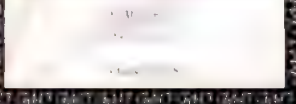
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At Home

A SPECIAL REPORT ON PRODUCTS FOR THE PERSONAL SIDE OF COMPUTING

THE TOP 100 CD-ROMS

IN THIS, OUR THIRD annual collection of the top 100 CD-ROMs available today, we find a multimedia and information market that continues to expand at an almost untrackable rate.

This is the first year that we present the listing in our PC Magazine At Home venue. As a result, you may notice a more "home and family interests" flavor to our selections and coverage. Yes, there's still a collection of home *office* titles, but in truth, CD-ROMs have always largely been geared to the home consumer market anyway. And though most applications you'll buy today come on CD-ROMs, you won't find them here. The same goes for magazine CD-ROMs, though one of our favorites (PC Magazine CD) is among them.

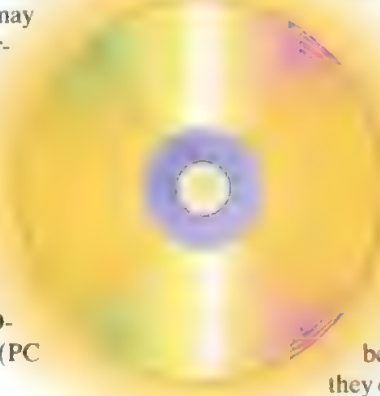
By Lance N. Ulanoff

We began by eliminating vertical and niche titles in favor of those for a wider audience. Our team of more than 30 evaluators tested more than 500 CD-ROMs; our original list went well over 800. All

titles here were published *after* April 1995.

We present the CD-ROMs in alphabetical order in all but two of the following five categories. Entertainment & Games and Educational Fun are both presented by age group.

Does this new list mean that the CD-ROMs we've covered in previous Top 100 lists are no longer any good? Absolutely not. In some cases, they've been updated and have made the list again. In others, they continue to be sold and should offer just as much as they did when we first covered them.





Laugh, watch, listen, and learn with these engaging educational multimedia CD-ROMs, which can enlighten even the youngest children.

PRESCHOOLERS

A to Zap! Street price: \$29.95. Sunburst Communications; 800-786-3155, 914-747-3310.

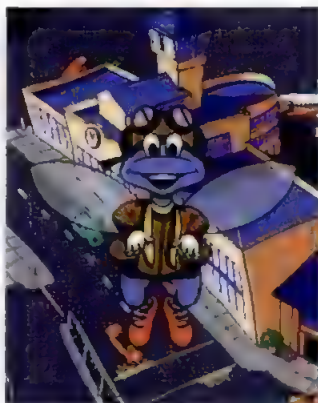
This educational Windows 3.1/95 CD-ROM for toddlers packs in plenty of sounds and animation to help children grasp the alphabet, words, and associations. The fun and creative word illustrations with the playful characters will surely captivate toddlers just beginning to read, as well as helping enhance their budding vocabulary and spelling skills. —Yvonne Koulouthros

Baby ROM! Your Child's First Software.

Street price: \$19.95. Byron Preiss Multimedia; 800-945-3155, 212-989-6252.

This Windows 95 CD-ROM's simple interface, bright colors, and lullaby-like tunes should engage even the youngest child. The activities range from basic letter games (with three levels, for 6 months to 4 years old) to shape and color matching. When babies

tire of the various games, they can stare at the black-and-white mobile while a lullaby plays. —LU



Let's Explore the Airport

Chicka Chicka Boom Boom. Street price: \$20. Davidson and Associates Inc. and Simon and Schuster Interactive; 800-457-8357, 310-793-0600. Davidson has taken a deceptively simple children's book and turned it into a full-featured Windows 3.1 CD-ROM with entertaining and educational activities that teach children their ABCs, as well as letter and word usage. There are new verses, and sections for singing along (with Ray Charles, no less), reading along, and music games. —LU

Sesame Street: Get Set to Learn!

List price: \$39.95. Creative Wonders; 800-543-9778, 415-573-8500.

A near-perfect companion to the Children's Television Workshop's show "Sesame Street," this cartoon-based

Windows 3.1/95 CD-ROM prepares preschool children for kindergarten and first grade by teaching them the basic letter, word, number, shape, color, and matching skills they'll need for school. The entire CD-ROM is in the format of a game show where children can choose to play any one of five games, each hosted by one of the "Sesame Street" characters. —LU

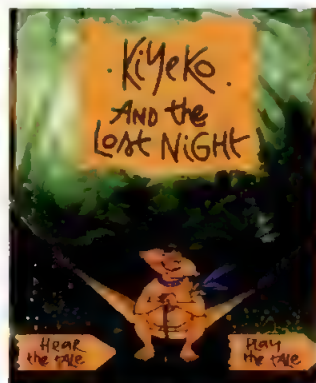
AGES 5-9

The Berenstain Bears Get in a Fight.

Street price: \$39.95. Living Books; 800-776-4724, 415-352-5200. In this new Windows 3.1 and Mac hybrid from Stan and Jan Berenstain, a small skirmish erupts between the two normally amiable sibling Berenstain Bears. As in other Living Books, dozens of entertaining hidden animations are everywhere. Woven throughout the story is an educational message for children about the importance of getting along, working things out, and being polite in general. —LU

Kiyeko and the Lost Night.

List price: \$29.95. Ubi Soft Entertainment; 800-824-7638, 415-464-4440. This Windows 3.1/95 CD-ROM does a fantastic job of welcoming one to the world of interactive storytelling. It offers the story in five different languages: English, Italian, French, Ger-



Kiyeko and the Lost Night



Magic Tales: The Little Samurai

man, and Spanish. The story takes the user into the Amazon Rain Forest, following Kiyeko on his journey to find the lost night. Throughout the Amazon Forest, you encounter over 220 musical and animated hot spots. —Charles Rodriguez

Let's Explore the Airport. Street price: \$19.95. Humongous Entertainment; 800-499-8386, 206-485-1212. Intended for kids ages 3 to 8, this Windows 3.1/95 CD-ROM captures all of the energy and excitement found in a real airport. With friendly tour guide Buzzy the Knowledge Bug, children can visit 40 locations and learn about more than 200 jobs, tools, and other airport-related objects. Other quality titles in this series include Let's Explore the Farm and Let's Explore the Jungle. —CR

Madeline Thinking Games.

Street price: \$39.95. Creative Wonders; 800-543-9778, 415-573-8500. Madeline, the Parisian star of the popular children's book series, has come to CD-ROM (Windows 3.1/95 and DOS). Once you're in Madeline's home, you can help her find her dog or visit one of five interactive rooms. Throughout, you'll find an entertaining and educational array of games for elementary-age children. —Cade Metz



Join senior associate editor Lance N. Ulanoff and members of the multimedia developers' community September 16 to 20 as they discuss CD-ROM technology, new Internet links, and what the future holds. And visit PC Magazine's site for links to the Web sites of many of the vendors covered here

WWW.PCMAG.COM

Our Contributors: HOLLY AGUIRRE, MARY E. BEHR, JAMIE M. BSALLES, ROBERT DALY, BRUCE DEODAT, JUDY DEYOUNG, CRAIG ELLISON, SIMON T. ESKOW, TODD M. FEINMAN, BEN Z. GOTTESMAN, ANGELA HICKMAN, BRYAN HUGHES, JAKE KIRCHNER, YVONNE KOULOUTHROS, REGINA Y. KWON, DAVID R. LAMBERT, JOSH LEVY, DAVID LIDSKY, MELANIO LOPEZ, CADE METZ, ARIE MOLLER, JAQUELINE PAREDES, MARY PAULSON, MELISSA J. PERENSON, MARGARET A. PIEMONTE, CHARLES RODRIGUEZ, PAUL B. ROSS, MICHAEL E. RYAN, MICHELLE SCHOENUNG, and NANCY SIRAPYAN are on the staff of *PC Magazine*. LANCE N. ULANOFF was the senior associate editor in charge of this story.

The Top 100 CD-ROMs

Magic Tales: The Little Samurai.

List price: \$35. Davidson & Associates Inc.; 800-545-7677, 310-793-0600.

This Windows 3.1/95 and Mac CD-ROM, adapted from the classic Japanese folk tale "Little One-Inch," features more than ten original finger-snapping and hand-clapping songs, loads of brilliantly animated click-and-explore interactivity, and a compelling storyline in which the boy Taro learns that there are more important things than the might of a sword.—*Angela Hickman*

Menlo The Frog: A Musical Fairy Tale.

List price: \$39.95. Windy Hill Productions Inc.; 800-850-4884, 415-854-6127.

Journey through the land of Once Upon A Time and help Menlo and Princess Winnicent protect music from the evil King of Later. That's the story



Madeline Thinking Games

behind this Windows 3.1/95 and Mac CD-ROM, which is fully equipped with adventure, games, music, and funny little characters that will keep kids enthralled for hours.—*Mary Paulson*

Mercer Mayer's Just Me and My Dad.

Street price: \$39.95. GT Interactive; 800-610-4847, 212-726-6500. Mercer Mayer's popular Just Me and My... series has lost nothing in its leap from out of the Broderbund Living Books stable. If anything, all the entertaining activity and hidden events are perfectly replicated and enhanced here in this Windows 3.1/95 and Mac CD-ROM. In the story, Mayer's adorable Little Critter character leads you on a happy camping trip with his dad. Along the way they encounter wildlife, weather a small storm, set up camp, and do a little fishing.—*LU*

The Playtoons Collection.

Street price: \$24.95 (series). Sierra On-Line; 800-757-7707.

The Playtoons Collection of four in-



Sesame Street: Get Set to Learn!

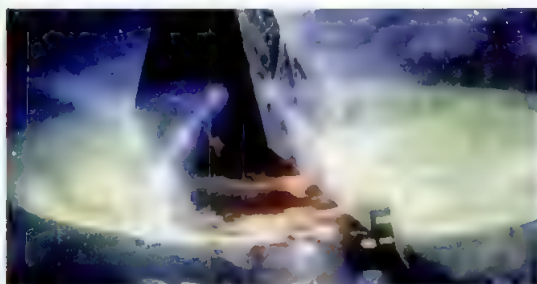
teractive mystery stories—Uncle Archibald, The Case of the Counterfeit Collaborator, The Secret of the Castle, and The Mandarin Prince—goes well beyond the traditional with fantastic, colorful animation and sto-

HIGHLIGHTS

Pet Peeves and CD-ROM Pleasures



Peeve: Yes, we've said this before, but could CD-ROM manufacturers please cut down on the excessive packaging? A 4.5-inch by 4.5-inch by 0.5-inch plastic jewel case doesn't need to be wrapped in cellophane if it's already in a cardboard box that *itself* is wrapped in cellophane—not to mention the excess cardboard thrown in just to fill out what is nearly an empty box, anyway.



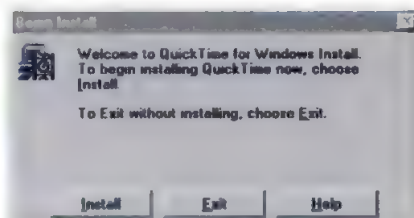
Pleasure: Video comes across much better on titles such as Wing Commander IV because developers have designed their own video playback technologies. Finally, we get to see nearly full-screen video without special hardware.



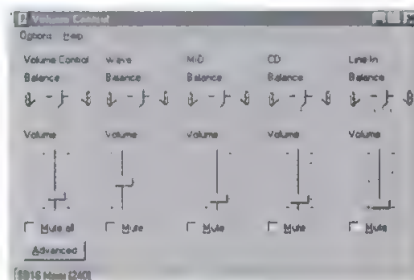
Peeve: Please, no more bad acting. Even good actors tend to overact on CD-ROMs. We know the sets we see are usually artificial, but does the acting have to be, too?



Pleasure: Enhanced-format CD-ROMs give you more bang for the buck. They extend your pleasure by including CD-audio-format music on your favorite CD-ROM.



Peeve: Do you think there will ever come a day when Apple's QuickTime will be smart enough at installation to know that you already have the latest version installed and don't need to have it reinstalled?



Peeve: Do any of today's multimedia CD-ROMs actually recognize the Windows sound settings? We've all covered our speakers—or our own ears—with our hands one too many times as we frantically searched for some way to lower the sound before our ears started bleeding.



Pantsylvania

ries that will keep even adults in suspense. Best of all, these Windows 3.1/95 and Mac programs each contain a construction game that allows you to use characters, scenes, and objects from the different stories to create your own.—MP

Scholastic's The Magic School Bus Explores the Ocean. Street price: \$44.95. Microsoft Corp.; 800-426-9400, 206-882-8080.

In this educational and entertaining Windows 95 CD-ROM (modeled after the popular PBS television show), Miss Frizzle and the gang take you out to sea to teach you about the science and biology of the ocean. Along the way, you'll also find lots of games (you collect fish cards as you play and win) and informative hot spots.—LU

AGES 9-13

Elroy Hits the Pavement. Street price: \$30.00. Headbone Interactive; 800-267-4709, 206-323-0073.

While parents are preoccupied with interactive movies featuring Mark Hamill and Margot Kidder, adolescents can indulge themselves with the animated equivalent starring that lovable rogue Elroy. Elroy's dog Blue (once the FBI's top bloodhound) is missing, and you must return him to safety. Throughout your escapades, this Windows 3.1/95 and Mac CD-ROM boasts an excellent sound track and a smart sense of humor.—CM

The Interactive Haggadah. Street price: \$49.95. JeMM Productions; 800-871-0694.

Now on CD-ROM, this popular Jewish children's book and video teaches the stories and rituals of the Passover holiday with tremendous depth of content. The Windows 3.1 program centers around a family sitting down for the Seder, the traditional Passover meal.—Ben Z. Gottesman

Juilliard Music Adventure. Street price: \$34.95. Theatrix Interactive; 800-955-8749, 510-658-2800.

More than just a mystical game of intrigue and adventure for kids, this DOS, Windows, and Mac CD-ROM is a learning tool designed to familiarize them with meter, rhythm, and melody,

encouraging them to learn to use these elements in compositions of their own.—MP

Pantsylvania. Street price: \$30. Headbone Interactive; 800-267-4709, 206-323-0073.

This Windows 3.1/95 and Mac CD-ROM from Headbone Interactive features the Gigglesome Gang (Bunji the Frog, Clyde the Parrot, and Svelte Velma the Swine), who guide children through the ten different areas of Pantsylvania. Each area contains five interactive activities, which teach things as simple as shape recognition and as advanced as social studies.—Michelle Schoenung

Quest for Fame. Street price: \$49.95. IBM Multimedia Studios; 800-426-7235.

With the help of the clever little V-pick included with this Windows 3.1/95 CD-ROM, your computer transforms into an electric guitar, and you're on your way to jamming with a video version of Aerosmith. You start by playing in your bedroom and eventually graduate to the level of garage band and beyond.—David R. Lambert

Science Sleuths 1: Mystery of the Blob and Mystery of the Exploding Lawnmowers. Street price: \$34.99. SoftKey International; 800-227-5609.

This Windows 3.1/95 and Mac series succeeds where so many "educational games" fail in making learning fun. Numerous video clips, hot links, and an offbeat sense of humor capture your child's interest, while sophisticated content reinforces science skills and teaches many new ones under the tutelage of Kathryn Wimshurst. Your goal is to use laboratory tools and deductive reasoning to solve a science mystery.—Regina Y. Kwon



*The Berenstain Bears
Get in a Fight*

SkyTrip America. Street price: \$39.95. Discovery Channel Multimedia; 800-678-3343, 301-986-0444.

This Windows 3.1/95 CD-ROM for kids ages 9 and up is a time-travel adventure that gives you an incredible ride through U.S. history. There are different games to help you sharpen historical and geographical skills. Among them are the Pony Express game, a game of hangman trivia in a ghost town, and a Mining Maze game.—Jacqueline Paredes

3-D Body Adventure. Street price: \$35.00. Knowledge Adventure; 800-542-4240, 818-246-4400.

Picture this: a cartoon skeleton jogging, juggling, and pulling body parts from his magician's hat. Sound bizarre? On the contrary, this is one entertaining fellow who sets the stage for your child's body adventure. This Windows 3.1/95 CD-ROM has six different sections—including 3-D Body Reference and the Visual Body—and a surprise: two sets of 3-D glasses.—Bryan Hughes



Mercer Mayer's Just Me and My Dad

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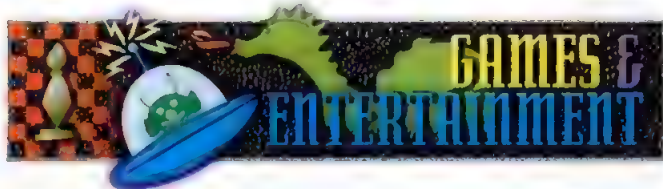
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Look out! Run! Duck! Strategize! Figure it out! Whatever your pleasure—action games, puzzles, passive entertainment—these gaming CD-ROMs will fill your days with thrills, chills, spills, and mind-bending puzzles.

FAMILY

Jungle Book. List price: \$39.95. IBM Multimedia Studios; 800-426-7235. Superb footage from the recent film is blended with new video and sound to bring you this lively Windows 3.1/95 CD-ROM. You can even talk into the microphone included with the package to mimic the featured chimpanzee and wolf. Throughout the program, memory games and other brain-teasers challenge your mental skills; every time you succeed, you collect a key that helps lead you to the missing treasure.—YK



*The Muppet CD-ROM:
Muppets Inside*

The Muppets CD-ROM: Muppets Inside. List price: \$39.95. Starwave Corp.; 206-957-2000.

Though this Windows 95 CD-ROM starts off like a typical "Muppet Show" opening, things quickly go awry as a technical glitch throws all the characters deep inside the workings of your computer. Among the highlights are a number of game shows and interactive games, including a DOOM-like first-person game in which you're the Swedish chef trying to wend your way through a kitchen maze gone out of control.—LU

TEEN-ADULT

Command & Conquer. Street price: \$59.95. Virgin Interactive Entertainment; 800-874-4607, 714-833-8710. This amazing strategy title for DOS will challenge even the best gamers with its frenetic combat action and its increasingly difficult missions. Game play involves commanding your troops through a series of battles for one of two sides in a global conflict. Also, Command & Conquer supports up to four players over IPX networks.—MER

Crusader: No Remorse. Street price: \$55. Origin Systems Inc.; 800-245-4525, 512-434-4263. Although it's a shoot-'em-up at heart, this DOS CD-ROM is unusual enough to stand out in this crowded genre. You play an assassin-turned-rebel in this futuristic action game. Over the course of 15 missions (each of which unfolds in intricately-detailed Super VGA set-

tings) you'll have to fight your way past your former employers while trying to win over your new allies.—MER

Descent II. Street price: \$50. Interplay Productions; 800-969-4263, 714-553-6678.

The sequel to one of last year's greatest games, this DOS/Windows 95 CD-ROM is a classic in its own right. Using one of the most remarkable graphics engines on the market, Descent II gives you a dizzying first-person perspective and a full, 360-degree freedom of movement.—MER

The DIG. Street price: \$54.95. LucasArts Entertainment Corp.; 800-985-8227, 415-472-3400.

This DOS game starts out in the dark reaches of space where you, as commander of the space shuttle *Atlantis*, have been tasked with nudging Attila the Asteroid off its collision course with Earth. What starts as a simple cut-and-dry mission to save planet Earth soon becomes a kidnapping of the intergalactic type. All the action takes place in an animated world peopled with cartoony characters.—AM

IndyCar Racing 2. Street price: \$54.95. Sierra On-Line; 800-757-7707. This simulation game puts you in the



Sting: All This Time

driver's seat for some of the fastest, most realistic racing action you can see on a Windows 95 or DOS PC. You can take your car out for a single race or an entire 15-race season on some of the most famous racetracks in the world. IndyCar Racing 2 also supports two-player races via modem or direct serial connection.—Michael E. Ryan

Mech Warrior 2. List price: \$19.95. Activision Inc.; 800-477-3650, 310-473-9200.

They walk like robots, shoot like tanks, and can even flit about like helicopters. They're Mechs, one of the hottest concepts to hit the combat-simulation market in recent years. This Windows 95 CD-ROM is the eagerly awaited sequel that provides all the firepower gamers could hope for.—DRL



Rebel Assault II: The Hidden Empire

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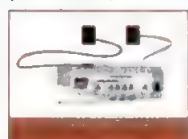


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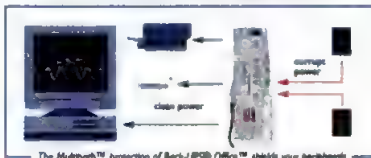
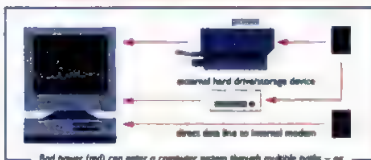
Unique Multipath protection keeps your PC and data safe

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Instantaneous Surge Protection			•
Surge	•	•	•
Spikes	•	•	•
Backlash	•	•	•
Brownout	•	•	•
Overvoltage	•	•	•
Common Voltage Reference			•
with Parallel (VFD) or IGBT inverter		10	10
APC's TruePower™ PC		•	•
Printer	•	•	•
Storage Device/Zip Drive	•	•	•
Modem	•	•	•
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The Top 100 CD-ROMs



On the Road With B.B. King

NBA Live 96. Street price: \$59.95. Electronic Arts; 800-245-4525, 415-571-7171.

This CD-ROM does such a thorough job of replicating the NBA experience you may end up preferring it to the real thing. You control every aspect of both the game and your viewing of it, so you don't have to worry about petulant millionaires head-butting referees. This level of involvement with the game makes the DOS-based program a delight for basketball fans.—*David Lidsky*

PGA Tour 96. Street price: \$59.95. Electronic Arts Inc.; 800-245-4525, 415-571-7171.

Golf may seem a dull candidate for translation to an entertaining video game, but PGA Tour 96 is anything but dull. With high-quality graphics and close attention to detail, this Windows 95 and DOS CD-ROM will entice even those who can't tell the difference between a birdie and a Bronx cheer.—*Simon T. Eskow*

Shanghai: Great Moments. List price: \$29.95. Activision Inc.; 800-477-3650, 310-473-9200.

Four delightfully animated variations of the simple tile-matching game Taipei are presented in this challenging Windows 95 CD-ROM. Slide tiles, drop them, even lay them face-down in the sanity-testing "contemplation mode." If you get stuck, simply consult actress Rosalind Chao, who is standing by in a corner window, waiting to help.—*DRL*

Sid Meier's Civilization II. Street price: \$49.95. MicroProse Software Inc.; 800-695-4263, 510-522-3584.

A follow-up to MicroProse's classic strategy game, the Windows 3.1/95-based Civilization II adds some interesting improvements, such as a revamped multimedia Wonders of the World, a deity level for the true diehards, and a ton of new ground, navel, and air units.—*Arie Moller*

Star Wars Rebel Assault II: The Hidden Empire. Street price: \$54.95. LucasArts Entertainment; 800-985-8227, 415-472-3400.

A movie adventure that returns you to the world of *Star Wars*, Rebel Assault II combines full-motion video with outstanding special effects. In this two-CD-ROM set (Windows 3.1/95 and DOS), Darth Vader is up to his old tricks, plotting to destroy the Rebel Alliance with a brand-new secret weapon.—*BH*

Terra Nova: Strike Force Centauri. List price: \$59.95. Looking Glass Technologies; 800-360-7455, 617-441-6333.

An exceptional first-person action game, this DOS CD-ROM will challenge your trigger finger and your leadership skills. In this science-fic-

tion thriller set in the Alpha Centauri star system, you play a hotshot squad leader who must equip, organize, and command a group of foot soldiers through more than 30 missions.—*MER*

Torin's Passage. Street price: \$59.95. Sierra On-Line; 800-757-7707.

Playing the title role in this Windows 3.1/95 and DOS CD-ROM, you must scour the five worlds of Strata in search of your missing parents—or at least, the people you thought were your parents. This comical, cartoon-style adventure game is full of challenging puzzles and bizarre characters. The game's spectacular graphics and music will draw you into Torin's world, and the pleasantly twisting plot will keep you there. This is one adventure that the whole family can enjoy.—*MER*

WarCraft II: Tides of Darkness. Street price: \$50.00. Blizzard Entertainment; 800-953-7669, 714-955-1380.

Be prepared to take the side of the Orcs or the humans in this real-time DOS-based strategy game from Blizzard. Following up on the original storyline of *WarCraft I*, the human al-



PGA Tour 96

liance has fallen back to the Isle of Lordaeron and is being mercilessly pursued by the Orcish Horde. This version of *WarCraft* allows for network-based multiplayer games of up to eight people.—*AM*

Whiplash. Street price: \$49.95. Interplay Productions; 800-969-4263, 714-553-6678.

If you ever wondered what it would be like to race around those old orange Hot Wheels tracks, you'll want to take a look at this DOS CD-ROM. Its arcade-style racing game is full of curves, jumps, and even loops, all of which will put your driving skills to the ultimate test. Super VGA graphics along with excellent sound and music help bring the action to life. Whiplash also supports multiple players—up to 16 over an IPX LAN.—*MER*

Wing Commander IV: The Price of Freedom. Street price: \$55. Origin Systems Inc.; 800-245-4525, 512-434-4263.

While its predecessor, *Wing Commander III*, pushed the envelope of what you could expect in action/adventure games, the DOS-based *Wing Commander IV* virtually explodes, with six CD-ROMs of pulse-quickening action. As reactivated ace pilot Colonel Christopher Blair (Mark Hamill), you choose the spacecraft and weaponry and fly all the missions (via keyboard, joystick, or mouse) on a hunt to outwit and defeat spacegoing pirates.—*LU*

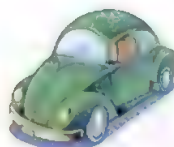


Whiplash

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The Top 100 CD-ROMs

ADULT

Bad Mojo. Street price: \$49.95. Pulse Entertainment; 800-264-0325, 310-264-5579.

Franz Kafka meets the gaming world in this unusual game, where you take on the role of the lowly cockroach. The premise of this Windows 3.1/95 game is that an unusual magical force has transformed your alter ego, Roger Samms, a mild-mannered entomologist, into the object of his studies, a cockroach. With over 800 navigable screens, *Bad Mojo* is a rich world of buggy excitement.—AM

The Beast Within: A Gabriel Knight Mystery. Street price:

\$64.95. Sierra On-Line; 800-757-7707, 206-649-4900.

Following Gabriel across the Atlantic, this Windows 95 CD-ROM continues where the original Gabriel Knight mystery game, *Sins of the Fathers*, left off. As Gabriel Knight's alter ego, you must hunt down those responsible for a series of bizarre attacks near Munich. This six-disk game is richly interwoven with actual imagery from Munich as well as a particularly eerie musical score.—AM

Dogz and Catz. Street price: \$19.99 each. PF.Magic; 800-482-3678, 415-495-0400.

These Windows 3.1/95 CD-ROMs are for all those people who want to take their pets to work with them but can't, or who can't own a pet at all. Each program allows the user to adopt a virtual-reality pet that lives

on the computer screen. While cartoonish in appearance, the pets are amazingly lifelike in their actions. With their constant need for attention, you'll often find yourself returning to your computer and virtually rubbing your pet's stomach or throwing it a ball.—BZG

Duke Nukem 3D. List price: \$39.95. 3D Realms Entertainment; 800-276-4331, 214-278-5655.

Although this DOS CD-ROM contains far too much adult content and language to be a family game, it's without a doubt the best first-person action game currently on the market. While the game's enemies, boss monsters, and many weapons are similar to those you'd find in *DOOM II*, *Hexen*, and other similar games, the Super VGA graphics and incredibly detailed level designs help to set Duke Nukem 3D apart.—MER

EF2000. List price: \$49.95. Ocean of America; 408-289-1200.

If realism is the key to a good simulator program, then this DOS-based flight combat simulator is very, very good indeed. Using recently declassified information from British Aerospace, EF2000 was designed to simulate the technically advanced Euroforce 2000 currently under development by Germany, Italy, Spain, and the United Kingdom. Pilots can direct up to four wingmen in combat or join other players to battle the enemy in networked play.—Craig Ellison



Duke Nukem 3D



The Beast Within: A Gabriel Knight Mystery

Forrest Gump: Music, Artists and Times. List price: \$29.95.

GTE Entertainment; 800-483-8362, 619-431-8801.

Even if you're one of the few people who never saw the movie, or one of the fewer still who hated it, you'll still find a lot to like about *Forrest Gump* the CD-ROM (Windows 3.1/95 and Mac). Fans of the movie will spend hours with the full film script and the video interviews with *Gump*'s writers, director, and composer contained in this three-CD-ROM set. The most attractive part of the set, however, is what amounts to an interactive version of the movie's soundtrack.—

Jake Kirchner

On The Road With B.B. King. List price: \$39.95. MCA Records Inc.; 818-777-4000.

If you're a fan of the blues, you owe it to yourself to check out this incredible Windows 3.1/95 CD-ROM presenting the life and times of B.B. King, as told by the man himself. You'll learn about everything from young Riley B. King's early musical experiences and influences to his recent work with U2. Throughout the title, animated sequences, video clips, photographs, and, of course, music help tell B.B. King's story.—MER

Steel Panthers. Street price: \$50. Strategic Simulations Interactive Inc.; 800-601-7529, 408-737-6800. Rewrite World War II history in this DOS-based strategy game, which

comes preset with several historical campaigns and one not-so-historical World War III campaign scenario. For the truly creative, a game editor is also available so you can build custom scenarios. Once your campaign is selected, you can take command of an impressive array of lethal weaponry, including more than 200 tanks and aircraft.—AM

Sting: All This Time. List price: \$39.95. Starwave Corp.; 800-457-8646, 206-957-2000.

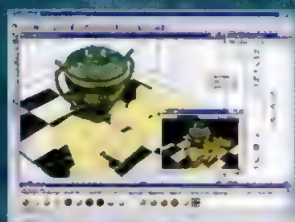
Sting's new Windows 95 CD-ROM mixes information about the former Gordon Sumner with games, mystery, and (of course) songs to unveil the man and help you understand his music. There are two landscapes to explore on this two-CD-ROM set: East and West. Because you have to hunt for items as you explore, it's more fun to learn about Sting than it is to use most other CD-ROMs of this ilk.—DL

ZORK Nemesis. List price: \$54.95. Activision Inc.; 800-477-3650, 310-473-9200.

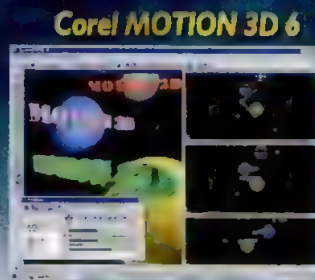
In this Windows 95 and DOS-based interactive adventure, you must find the secret of the Nemesis curse, which has bound four prominent people in a living tomb within the Temple of the Ancients. It's your job to free them using the arts of alchemy. Along the way you'll be confronted with more than 65 puzzles, such as headless bodies and other disturbing imagery, as well as strange rites of magic.—AM

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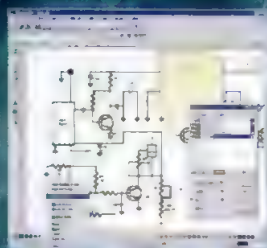
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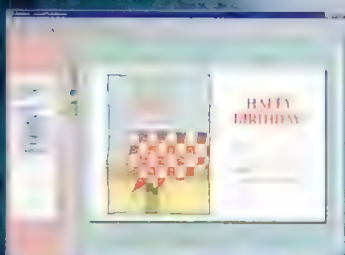
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Whether you're puttering around the garden, diagnosing an ache, or whipping up dinner, these CD-ROMs can help make your home endeavors successful.

The AMA Family Medical Guide.

Street price: \$40. DK Multimedia; 800-256-6575, 212-213-4800.

This Windows 95 CD-ROM covers diseases, disorders, and other problems. Sections include Atlas of the Body, Your Healthy Body, Injuries and Emergencies, Diagnostic Imaging Techniques, and Caring for the Sick. Some sections are self-explanatory, and all are quite informative. The animations that teach the Heimlich maneuver and CPR are invaluable.—*LU*



Better Homes and Gardens Presents Great American Cooking

Better Homes and Gardens Presents Great American Cooking.

Street price: \$35. Multicom Publishing; 800-850-7272, 206-622-5530.

A great tool for the experienced cook as well as the beginner, Great American Cooking (Windows 3.1/95 and Mac) immediately captivates the user with its picturesque main menu. Modeled after a kitchen counter, it offers a number of tantalizing areas where you can begin your cooking journey, including Recipe Selections, Video Techniques (which teaches cooking methods), Meal Planner, and Healthy Cooking.—*Margaret A. Piemonte*

BodyWorks 5.0.

Street price: \$50. SoftKey International; 800-227-5609, 617-494-1200.

This Windows 3.1/95 CD-ROM takes you on an in-depth journey into the far reaches of human anatomy and is filled with text, movies, and 3-D images. There are 6 different 3-D models, 12 anatomical systems, lectures on the body's systems, and a Body Basic game.—*BH*

Classic Rock Guitar, Volume 1.

List price: \$59.95. Ubi Soft Entertainment; 800-824-7638, 415-547-4000.

Drop your air guitar, pick up a Gibson, and check out this easy-to-use Windows 95 CD-ROM. A virtual music instructor, Classic Rock Guitar provides step-by-step, detailed guidance through eight popular rock favorites. There are 80 lessons, 180 exercises, video tutorials, and even a metronome to help you keep time.—*STE*

The Complete Maus.

List price: \$49.95. The Voyager Company; 800-446-2001, 212-431-5199.

More than simply a comic novel transferred to disk, this Windows 3.1/95 and Mac hybrid enriches Art Spiegelman's Pulitzer Prize-winning account of his father's life before, during, and after his internment in the German death camp at Auschwitz. The CD-ROM uses video accounts of Spiegelman's creative process, portions of the original taped interviews with his father, and even discussions about the process of bringing the book to a multimedia platform.—*LU*

Consumer Reports Cars: The

Essential Guide.

Street price: \$20. Creative Multimedia Corp.; 800-262-7668, 503-241-4351.

This Windows 95 CD-ROM delivers *Consumer Reports'* expertise on more than 7,000 new and used cars in the magazine's familiar no-nonsense, we're-not-beholden-to-anyone style. The content is divided into five areas, with the real meat appearing in the section on how to buy a new or used vehicle and in the exhaustive catalog of cars.—*Jamie M. Bsales*

The Crucible CD-ROM.

List price: \$49.95. Penguin Books USA Inc.; 800-331-4624, 212-366-2000.

This scholarly and engaging Windows 3.1/95 CD-ROM, based on Arthur Miller's play *The Crucible*, contains a wealth of information not only for the playwright's fans but also for those interested in the anti-Communist movement of the 1950s and in the 17th-century Salem witch hunt. The CD-ROM organizes its information around a theater-lobby metaphor and divides the material into seven sections, including The 17th Century, The 1950s, and The Play.—*Nancy Sirapyan*

French Your Way.

List price: \$125. Syracuse Language Systems Inc.; 800-797-5264, 315-449-4500.

A Windows 3.1/95 program, this French-instruction CD-ROM provides both flexibility and ease of use. You can choose a virtual conversation or skill-building games



BodyWorks 5.0

and activities, including crossword puzzles, question-and-answer routines, dictation, menu and map games, and speech recognition (microphone included), which evaluates your French pronunciation. A handy toolbar provides a French/English glossary, grammar notes, a verb conjugation guide, a topical index, and online help.—*Judy DeYoung*

Learn to Speak Spanish, Version

6.0. Street price: \$109. SoftKey International; 800-949-4379, 617-494-1200.

In 30 chapters, this interactive Windows 3.1/95 and Mac Spanish course not only guides you through vocabulary lists but provides you with a host of other effective learning methods. One of the most impressive sections is a voice recognition module that rates



Learning to See Creatively: Better Photography

The Top 100 CD-ROMs



French Your Way

your accent. There are also word games ranging from Go Fish to a crossword puzzle built from each chapter's word list.—AM

Learning to See Creatively:

Better Photography. List price: \$59.95. DIAMAR Interactive; 800-234-2627, 206-340-5975.

This CD-ROM (Windows 3.1/95 and DOS) is based on one of three books by professional photographer Bryan Peterson. He focuses on using design elements—line, shape, color, pattern, and form—to produce a striking photograph. Peterson does not abandon technical accuracy and proficiency, however. He includes sections on the scientific aspects of photography.—*Mary E. Behr*

Michael Jackson's World Beer

Hunter. Street price: \$35. Discovery Channel Multimedia; 800-678-3343, 317-579-0413.

This Windows 3.1/95 CD-ROM is a must-have for the beer enthusiast. The Discovery Channel's Michael Jackson takes you from Amsterdam pubs to African breweries in your quest for the best brews. For any

given beer you will find multiple entries: a few pages about the brewery, notes about the type of beer (lager, porter, and so on), and even audio clips describing the best places to find your beer of choice and what to eat with it.—DRL

Microsoft Cinemania 96. Street price: \$35. Microsoft Corp.; 800-426-9400, 206-882-8080.

Still the best movie reference around, this Windows 95 CD-ROM remains unbeatable in terms of both the breadth and depth of the content, as well as its impeccable organization. You can conduct searches for movie titles or actors, and you can browse through the selection of over 20,000 film reviews. Cinemania can even help you select your next video rental, with suggestions across a wide variety of genres.—*Melissa J. Perenson*

Microsoft Music Central 96.

Street price: \$45. Microsoft Corp.; 800-426-9400, 206-882-8080.

Microsoft bills this Windows 95 title as "your interactive one-stop music source," and that's just about right. It answers nearly every question you could have about the popular music for sale today, with resources including a 60,000-album discographic database, biographies of 8,000 artists, reviews of thousands of albums, 2,000 portraits and biographical essays from *The Guinness Encyclopedia of Popular Music*, and hundreds of video and sound clips of artists performing their work.—JK

Nine Month Miracle. Street price: \$40. A.D.A.M. Software; 800-408-2326, 770-980-0888.

Adam and Eve (of anatomically correct fame) are going to have a baby, and you're invited. An animated family album guides adults and youngsters through the nine-month process, from conception and morning sickness (which, as Eve will tell you, doesn't happen just in the morning) to food cravings and fetal development. This Windows 3.1/95 CD-ROM also addresses some of the stresses a pregnancy can put on a relationship, all in a realistic, reassuring fashion.—RYK



The Complete Maus

Picture Perfect Golf. Street price: \$29. Interactive; 212-221-6559.

Teeing off at the Coeur d'Alene no longer requires a plane ticket to Idaho and a pair of gaudy knickers. Using thousands of actual photographs, this Windows 95 CD-ROM has flawlessly reproduced the renowned lakeside course. You can now play the famous fourteenth hole and the infamous "floating" green without moving from your PC or changing out of your cut-offs. Although the course is great fun to play solo, you can also play against live opponents and automated players of various skill levels.—CM

ScruTiny in the Great Round.

Street price: \$40. Calliope Media; 800-336-2947, 310-829-1100. Imagine if Salvador Dali decided to work on a multimedia product and you'll have a good idea of what this



Michael Jackson's World Beer Hunter

interactive poetry CD-ROM (Windows 3.1/95 and Mac) is all about. Authors Tennessee Rice Dixon and Jim Gasperini first conceptualized the project as an art book. Each page contains truly bizarre—and imaginative—animations, and equally bizarre poetry.—AM

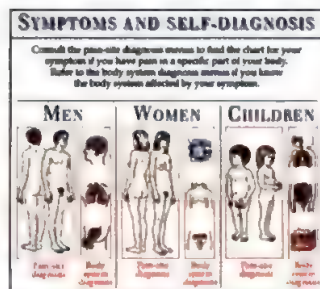
Slopestyle: An Interactive Learning Cube. Street price: \$30.

L3 Interactive; 800-644-2823, 310-264-4188.

With its off-center, MTV-style video footage and innovative Learning Cube teaching method, Slopestyle is a smooth introduction to snowboarding. The "cube" has nine panels: three beginner lessons (equipment and basic turning), three intermediate lessons (catching air), and three advanced lessons (trick moves and cliff drops). This Windows 3.1/95 CD-ROM is an excellent resource for beginners or those trying to master advanced maneuvers.—MS



Microsoft Music Central 96



The AMA Family Medical Guide

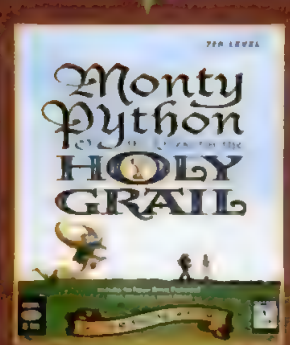


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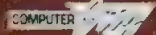
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Telecommuting and running small home-based businesses have become a way of life for many. These tools should improve your chances of business success.

C & C++ Multimedia Cyber Classroom. List price: \$69.95. Prentice Hall; 800-811-0912.

This interactive Windows 3.1 CD-ROM, taught by two professors, Harvey and Paul Deitel, makes learning how to program in C++ easier than ever. Cyber Classroom contains over 300 programming examples and more than 4 hours of audio that teach all the C and C++ concepts and commands. It discusses good programming practices and common errors, and it provides tips for optimizing your code, live code examples, and advice for writing across platforms.—*Todd M. Feinman*

Chivas Regal's Career Toolbox. List price: \$4.95. Chivas Regal; 800-244-8271.

This CD-ROM (Windows 3.1/95 and Mac) is jam-packed with expert advice and with resources for managing your career, including tips on becoming your own boss and on selling your expertise. There's also a listing of 20 hot new jobs, as well as a forecast of

the job market in the year 2005. Updates to this informative CD-ROM are downloadable via Chivas Regal's Web site.—*Bruce Deodat*

InfoMedia: Object Series 15. Street price: \$149. PhotoDisc Inc.; 800-528-3472, 206-441-9355. If you collect images, you know how



Learn To Do Windows 95 with John C. Dvorak

difficult it is to sift through all those filenames without knowing their content. This CD-ROM (Windows 3.1/95 and Mac) is perfect for organizing and



The Ultimate Job Source (Special Edition)

searching extensive collections of graphics files, and it provides a fair amount of good, royalty-free stock photography.—*STE*

tions, can answer that dreaded question, "Do I need a lawyer?" It's designed to make you a better-educated consumer of legal services, and it explains the law so clearly that you can complete forms relegating your attorney to a minor role. In addition to an extensive business-law library, there are forms covering eight major legal categories.—*DL*

Learn To Do Windows 95 with John C. Dvorak. List price: \$39.95. Allegro New Media; 201-808-1992.

You know you'll have to learn Windows 95 at some point; you might as well do so with customized help from an expert with a sense of humor. John C. Dvorak's lessons blend his wry comparison of the new and the old Windows, some truly useful tips, screen demonstrations of how things work under Windows 95, and tools for navigating this Windows 3.1/95 CD-ROM to build a personal path to Windows 95 competence.—*Paul B. Ross*

Presentation Audio. List price: \$49.95 per volume; set, \$199.95. Network Music Inc.; 800-854-2075, 619-451-6400.

Network Music's five-CD-ROM set (Windows 3.1/95) empowers you to build a presentation with the coolest sounds imaginable. The sonic palette comprises five volumes: Business/Office, Pop Culture, High-Tech/Electronic, Environments/Atmospheres, and Comedy/Animation. You can search for clips based on keywords, and you can choose 22-kHz or 11-kHz output.—*PBR*

The Interactive Manager Series: High Performance Management.

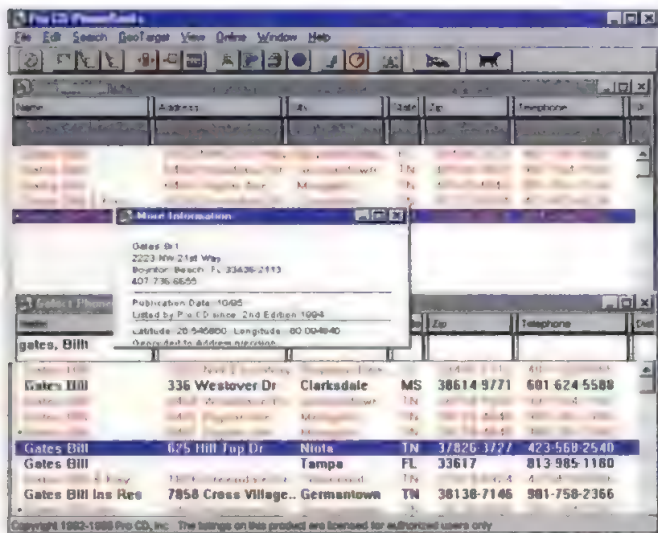
List price: \$500. Harvard Business School Publishing; 800-795-5200, 617-496-6384.

This three-disk interactive course can help anyone with management skills. Based on Linda Hill's *Becoming a Manager*, the CD-ROMs (Windows 3.1/95 and Mac) discuss general theories and challenges, management of employees in your workgroup, and ways to deal with your peers and your boss. They also provide detailed resources on such topics as hiring, coping with stress, and managing your career.—*JK*

Kiplinger's Small Business Attorney MultiMedia. Street

price: \$50. Block Financial Software; 800-813-7940.

This Win 3.1/95 CD-ROM, which addresses many common legal situa-



Select Phone Deluxe

The Top 100 CD-ROMs

Print Shop Deluxe Ensemble II.

Street price: \$79. Broderbund Software Inc.; 800-521-6263, 415-382-4400.

No longer a DOS-based printing program, Print Shop has advanced to a robust Windows 95 CD-ROM. You can use it for various types of projects, including greeting cards, invitations, signs, banners, certificates, and stationery. You can start from scratch or use one of the 500 premade projects.—MAP

ResumeMaker Deluxe CD.

Street price: \$40. Individual Software Inc.; 800-822-3522, 510-734-6767.

A truly helpful asset for anyone seeking a job, this Windows 3.1/95 CD-ROM takes on the role of your personal headhunter (short of offering you employment). Its career-center interface provides links to résumé and letter templates, a workshop with live-video virtual interviews, and a contact manager. The CD also includes a career planner.—YK

Select Phone Deluxe.

Street price: \$169. Pro CD Inc.; 508-750-0000.

In addition to a remarkably complete and accurate phone listing, this six-CD-ROM set (DOS, Windows 95, and Mac) has an exceptionally well-thought-out interface. Every listing consists of the name, address (including city, state, and full ZIP code), telephone number, SIC code (if available), and date the listing was published. User-selected listings appear in the tag manager, and you can use the different CD-ROMs to build a selection list from regions across the country.—LU

The Ultimate Job Source (Special Edition).

List price: \$49.95. InfoBusiness Inc.; 800-657-5300, 801-221-1100

This Windows 3.1 CD-ROM is a great way to start your job search. It's loaded with information on how to find the job you want, and it adeptly takes you through the process of identifying your skills and matching them with a career. You get advice on starting your job hunt, building a résumé, and interviewing.—Melania Lopez



Though these CD-ROMs take up less space than almost any book on your shelf, they offer far more pieces of information and useful insight, and all are neatly packaged with engaging multimedia.

ABC Sports Presents: Florida State Football.

List price: \$49.95. Stella Interactive; 800-619-4691, 619-431-8221.

As host of the ABC Sports college football CD-ROM series—which also includes disks on Michigan, Notre Dame, Ohio State, Penn State, and USC—ABC Sports commentator Keith Jackson provides an inside look at the country's premiere pigskin programs. Each disk (Windows 3.1/95 and Mac) provides a brief historical overview of a team, complete with photos, captions, narration, and digital video covering some of the greatest college games of all time.—CM



ABC Sports Presents: Florida State Football

Cartopedia: A World Reference

Atlas. Street price: \$50. DK Multimedia; 800-256-6575, 212-213-4800. This attractive, easy-to-use atlas CD-ROM (Windows 3.1/95) is chock-full of audio and video: Cartopedia combines high-quality maps and detailed indexes with intriguing slide shows, movies, and snapshots depicting exotic places. There are two sections of encyclopedic information: a list of countries with links to economic and political statistics, and a hyperlinked index of place names.—Josh Levy

Charlton Heston's Voyage Through the Bible, New Testament.

Street price: \$29.95. Jones Digital Century; 303-792-3111.

Still riding the coattails of his performance in Cecil B. DeMille's 1956 film *The Ten Commandments*, Charlton Heston now brings the Bible to the masses via CD-ROM (Windows 3.1/95 and Mac). Here, 15 redactions from the New Testament are accompanied by videos, artwork, and music. An examination of the ancient lands of Galilee, Samaria, and Judea and a look at Jerusalem complete the offerings.—CM

CNN Time Capsule: The Defining Moments of 1995.

List price: \$39.95. Graphix Zone; 800-828-3838, 714-833-3838.

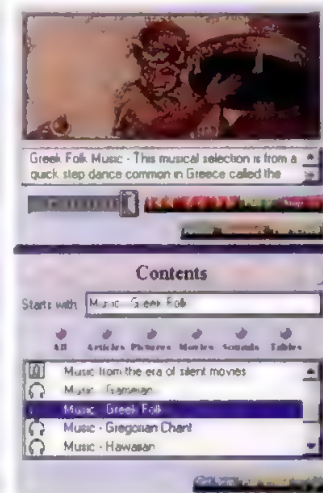
This multimedia compendium presents 1995's top news stories with depth and detail. Aesthetically organized and easy to navigate, Time Capsule (Windows 3.1/95 and Mac) draws upon CNN's vast resources, offering background articles, the text of stories filed by CNN correspondents, audio narratives by correspondents, and video excerpts from correspondents' on-air reports.—MJP

Compton's Interactive Encyclopedia 96.

Street price: \$50. SoftKey International; 800-227-5609, 617-494-1200.

A clear, colorful interface makes getting around this extensive interactive encyclopedia a cinch. You can search through reams of articles, which are hot-linked to rele-

vant subjects (the articles have sound, video, and even animation); you can also create your own show from clips, follow a time line, or explore maps or history. In addition to the contents of this Windows 3.1/95 CD-ROM's print counterpart (all 26 volumes), you'll find a dictionary and a thesaurus, over 8,000 pictures, and more than 100 full-motion videos.—YK

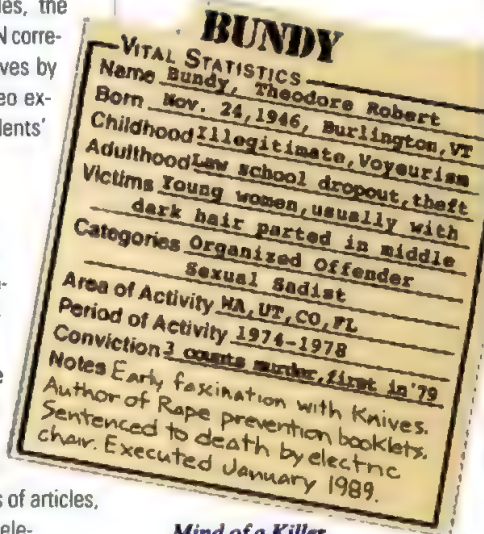


Compton's Interactive Encyclopedia 96

Critical Mass: America's Race to Make the Atomic Bomb.

Street price: \$55. Corbis Corp.; 800-246-2065, 206-641-4505.

For any history buff who's interested in the Manhattan Project, this Windows 95 CD-ROM is an excellent reference work. Half the material covers the events leading to Trinity and the bombings of Hiroshima and



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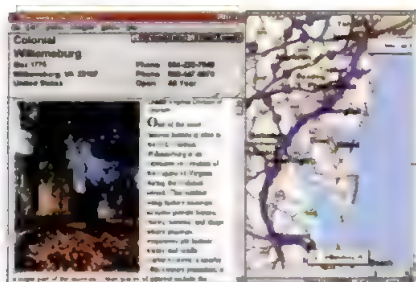
The Top 100 CD-ROMs

Nagasaki, and the rest discusses the American cultural, political, and military responses to the nuclear age.—*Robert Daly*

Events That Changed The World.

List price: \$29.95. ICE (Integrated Communications and Entertainment); 416-868-6423.

This CD-ROM (DOS/Windows 3.1/Mac) covers 60 turning points during 2,000 years of history. It highlights variations in religious, scientific, and political thought, and it shows these ideas' relationship to world events. This aspect makes the program far more interesting than your standard interactive encyclopedia.—*MP*



TripMaker 1996 Edition

Fighting Irish: The History of**Notre Dame Football.**

List price: \$49.95. MacMillan Digital, USA; 800-910-0099, 212-654-8500.

From Knute Rockne to Lou Holtz to Touchdown Jesus, this CD-ROM (Windows 3.1/95 and Mac) visits every famous figure in Notre Dame's gridiron history. Highlights include the Games section, which provides text, photos, and video for every Irish Bowl game and links to tales of winning streaks, rosters, and anecdotes; and the entertaining Fact, Fiction, and Folklore section.—*CM*

How Your Body Works.

Street price: \$39. Mindscape; 800-234-3088, 415-897-9900.

Part reference library, part Discovery Channel, and part health-class filmstrip, this Windows 3.1 multimedia encyclopedia explains the human body's processes and systems through easily understandable narrations. There are excellent 3-D animations, fly-throughs, and cut-aways.—*JMB*

Inside the SAT.

Street price: \$30. The Princeton Review; 617-272-7027. A great tool for those who want to improve their SAT scores, this Windows 3.1/95 and Mac CD-ROM has an attractive interface modeled after a high-school hallway. Every door opens into a different aspect of the SAT process, including sessions with a guidance counselor, strategies in general and for the verbal and math portions, the actual tests, and post-test analyses.—*YK*

Inside the Vatican.

List price: \$49.95. Jasmine Multimedia Publishing Inc.; 800-798-7535, 818-780-3344. Sir Peter Ustinov's tour of the Catholic Church's seat (Windows 3.1/95 and

DOS) is a must for nearly any CD-ROM reference shelf. Six libraries—Upon This Rock, Visions of Glory, The Flight from Rome, The Renaissance, The Changing Consciousness, and The Third Millennium—examine the complete history of the Vatican and the Catholic Church. There's

also a library of artwork and an archives link.—*CM*

A Jack Kerouac ROMnibus.

List price: \$49.95. Penguin Books USA; 800-331-4624, 212-366-2000.

When Jack Kerouac wrote his famous magnum opus *On the Road* in the 1950s, he could not have known that he would become one of the century's cultural icons. This Windows 3.1/95 CD-ROM focuses on Kerouac's life, his writings, and his exploits with

other members of the Beat Generation. Among the highlights are never-before-published drawings, paintings, and journals by Kerouac, and a Beat family tree.—*MS*

Life's Greatest Mysteries.

Street price: \$40. A.D.A.M. Software; 800-408-2326, 770-980-0888.

Do you really understand how your memory works? Life's Greatest Mysteries, a Windows 3.1/95 and Mac CD-ROM, tries to answer this and other vexing questions. There are four main topics: Body, Curiosities, Mind, and Sickness. Each section includes an animation clip explaining the topic, along with activities to demonstrate the concepts.—*AM*

Mind of a Killer.

Street price: \$30. Cambrix Publishing; 818-992-8484.

This Windows 3.1/95 CD-ROM offers everything you ever wanted to know about serial killers but were afraid to ask. The Overview section provides an in-depth look at the serial killer, with text and photographs covering such topics as "Defining Serial Murder" and "Growing Up a Murderer." The Case Studies section profiles roughly 20 killers and includes artifacts such as letters from Jack the Ripper and paintings by John Wayne Gacy.—*CM*

Multimedia Space Explorer**Version 3.0.**

List price: \$29.95. Betacorp Multimedia; 905-564-2424. This impressive CD-ROM (Windows 3.1/95 and DOS) is a complete history of the national and international space programs. There are eight sections:

Space Timeline, Multimedia Library, Unmanned Missions, Technology and Science, Shuttle Research, Manned Missions, Future Explorations, and Exploring the Solar System. Almost every topic includes either full-motion MPEG video clips or still shots.—*MEB*

A Passion for Art: Renoir, Cézanne, Matisse and Dr.

Barnes. Street price: \$40. Corbis Corp.; 800-246-2065, 206-641-4505. This Windows 3.1 CD-ROM marks the first time in 70 years that the public has had access to the Barnes Foundation's art collection, one of the largest private collections of Impressionist and Postimpressionist art. For those who enjoy tours, this CD-ROM offers three: the foundation's origin and mission, and the themes of the female nude and the dance in Impressionist art.—*RD*

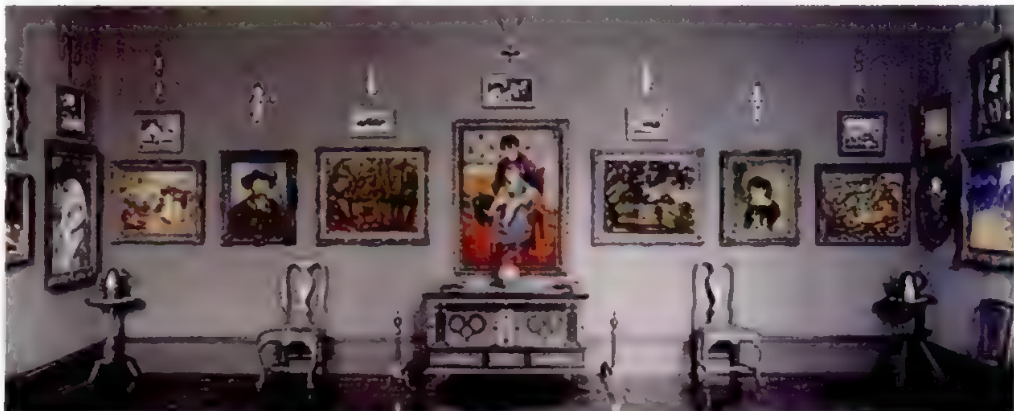
Precision Mapping 2.0.

Street price: \$39. Just SoftWorks Inc.; 708-257-7616.

The most comprehensive street-map program available, this Win 3.1 CD-ROM can find almost every street in the United States. It includes an easy-to-use search engine, a simple and intuitive interface, and a richly detailed graphical map that supports any resolution. The program can search according to area code or even street number. You can also measure distance in a map, edit the map with text or objects, print it, and save it.—*TMF*

Redshift 2.

List price: \$54.95. Maris Multimedia; 800-639-8717, 415-492-2819.



A Passion for Art: Renoir, Cézanne, Matisse and Dr. Barnes



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Abstract—The purpose of this study was to determine the effect of a 12-week training program on the heart rate (HR) and oxygen consumption ($\dot{V}O_2$) of sedentary, middle-aged men. The subjects were divided into two groups: a control group and a training group. The control group consisted of 10 men who did not exercise regularly, and the training group consisted of 10 men who exercised regularly. The training program consisted of 12 weeks of aerobic exercise, 3 times per week, for 30 minutes per session. The HR and $\dot{V}O_2$ were measured at rest and during maximal exercise at the beginning and end of the training program. The results showed that the training program had a significant effect on the HR and $\dot{V}O_2$ of the training group, but not on the control group. The HR and $\dot{V}O_2$ of the training group increased significantly from the beginning to the end of the training program, while the HR and $\dot{V}O_2$ of the control group remained unchanged. The results suggest that a 12-week training program can improve the cardiovascular fitness of sedentary, middle-aged men.



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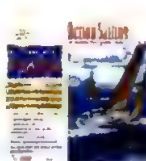
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AT HOME

The Top 100 CD-ROMs



Wild Blue Yonder Deluxe Edition

Redshift remains the perfect multimedia companion (Windows 3.1/95 and Mac) for neophyte and expert astronomers. Narrated, animated tours introduce basic concepts, and a peek into Penguin's illustrated *Dictionary of Astronomy* is only a hyperlink away. Experts will appreciate all the controls and filters that determine which planets you view and that give your position on Earth, the date (4712 B.C. to 10000 A.D.), and constellation information.—RYK

Sports Illustrated Multimedia Almanac 1995 Edition. Street price: \$25. Graphix Zone; 800-828-3838, 714-833-3838.

Rather than keeping a mildewed stack of the year's 52 *Sports Illustrated* issues in the back of your closet, you can now get the same material—plus an extensive video library and a game of sports trivia—on a single svelte, silver disk. This exhaustive Windows 3.1/95 and Mac CD-ROM includes four sections: SI Magazine, Year in Review, Media Gallery, and Almanac.—CM

TripMaker 1996 Edition. Street price: \$35. Rand McNally New Media; 800-671-5006, 847-329-8100. Packed with maps and useful destination information, TripMaker (Windows 3.1/95) is your domestic excursion companion. Its Explorer Guide introduces you to places you can visit, and the Trip Guide walks you through the process of planning a trip and mapping out the quickest and most scenic route, right down to calculating the mileage and the driving time.—MJP

U.S. News: Getting Into College. Street price: \$29.95. Creative Multimedia; 800-262-7668, 503-241-4351. In this Windows 95 CD-ROM, *U.S. News & World Report* has amassed

a library of information on everything you need to know about the college selection and preparation process, from locating and ranking colleges to applying for admission. The product ranks over 1,400 colleges and universities, offering expert advice based on your preferences. Multimedia interactive tours show you photographs in conjunction with sound and video clips of hundreds of campuses.—BD

The War in Vietnam. Street price: \$39.95. Macmillan Digital, USA; 800-910-0099, 212-654-8500. *The New York Times* and CBS News have collaborated to bring us the most complete Vietnam CD-ROM produced to date (for DOS, Windows 3.1/95, and the Mac). The topics that are covered include weapons, biography, maps, and more. There is also a time line with links to related text from *New York Times* articles, along with videos from the CBS archives. The Honors section provides a searchable database of military awards as well as casualties of the war.—DRL

Wild Blue Yonder Deluxe Edition. Street price: \$19.95. Cambrix Publishing; 818-992-8484. This impressive two-CD-ROM title (Windows 3.1/95) covers the history of aviation with unusual style and aplomb, from the Wright brothers at Kitty Hawk to experimental Stealth jets. The first CD-ROM covers "50 Years of Gs and Jets," and the second, "The Golden Age." Choosing an era from among the four listed on each CD-ROM brings up half a dozen or more images of planes from that time period. Click on any one of these images for a video clip and a menu of options that includes Stories, Specs, Cockpit, and Black Box.—RYK □

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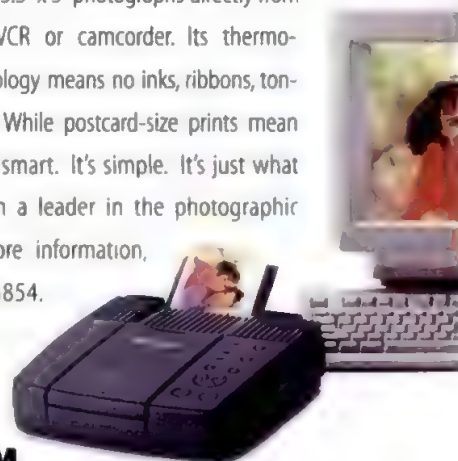
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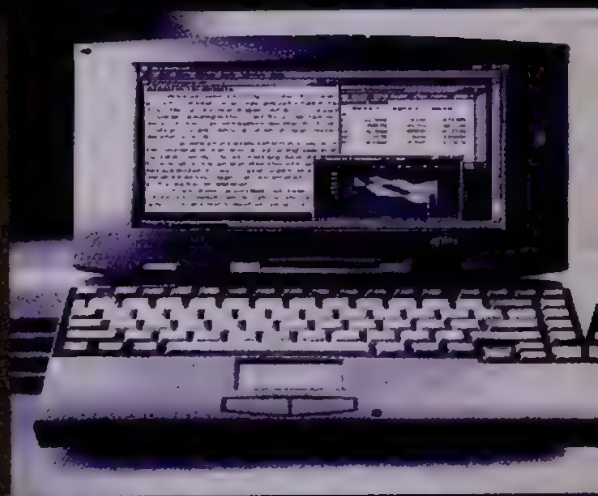
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Advertisers' Index COMPANIES

Reader Service No.	Advertiser	Page
293	3 Com Corporation	46-47
205	3M Visual Systems Division	23
383	7th Level Inc.	334
226	ADI Systems Inc.	53
235	AMS	42
122	AST Research	200-201
*	AT&T	223-225
059	ATI Technologies	32-33
034	Acer America	90-92
218	Adaptec	320
887	American Power Conversion	NE25
162	American Power Conversion	327
*	Apple Computer	130-131
*	Apple Computer	133
336	ARLINGTON COMPUTER PRODUCTS	266
858	Artisoft Inc.	NE18
864	Attachmate IPG	NE16
012	Austin Direct	249-252
934	Axis Communications, Inc.	NE17
*	Bold Data	165
208	Brother International Corp.	84
329	CTX International	74
292	Caere Corporation	6
*	Citrix	NE31
*	Canon Computer Systems	2-3
*	Compaq Computer Corporation	70-71
*	Compaq Computer Corporation	140-141
387	CompuLink Research	243
360	COMPUTER DISCOUNT WAREHOUSE	235
318	COMPUTER DISCOUNT WAREHOUSE	236-237
159	COMPUTER DISCOUNT WAREHOUSE	238-239
109	COMPUTER DISCOUNT WAREHOUSE	240-241
348	CompuTrend, Inc.	195
369	Connectix	215
314	Corel Corporation	14-15
037	Corel Corporation	96
258	Corel Corporation	159
044	Corel Corporation	325
103	Corel Corporation	331
041	Corel Corporation	337
322	Corel Corporation	340
042	Corel Corporation	343
343	Cyril Corporation	190-191
*	Executive Software	NE28
*	Executive Software	116
*	Dell Computer Corporation	68
*	Dell Computer Corporation	C5-C8
189	Diamond Multimedia Systems	342
*	EIZO NANO Technologies, Inc.	72
*	Epson America	10-11
*	Epson America	59

Reader Service No.	Advertiser	Page
240	ESRI	210
256	EXP Memory Products	339
014	First Source International	269
294	Fuji Computer Media	341
114	Fujitsu PC Corporation	54-55
224	Fujitsu PC Corporation	56-57
*	Gateway 2000	48A-49
367	Goldstar Electronics	28
391/138 H. Co./MicroMall		267
062	HARTFORD COMPUTER GROUP	270-271
926	Hayes Microcomputer Products	NE25
*	Hewlett Packard	50
*	Hewlett Packard	78-79
*	Hewlett Packard	161
854	Hewlett Packard-Colorado Memory Systems	NE10
073	Hewlett Packard-Colorado Memory Systems	35
*	IBM Corporation	NE7
*	IBM Corporation	81
*	IBM Corporation	173
167	Insight Direct	272-273
278	Insight Direct	274-275
219	Insight Direct	276-277
895	Insignia Solutions	NE29
*	Intel Corporation	162-163
*	Intel Corporation	179-182
166	Intercon Corp.	216
106	Kingston Technology	13
859	Kingston Technology	NE23
869	Kyocera Electronics, Inc.	NE22
019	L.A. Trade	278
*	Lotus Development Corporation	38
006	Luckman Interactive	220
165	Magitronic	255
045	Magix	244
299	McAfee Associates, Inc.	156
283	MEGAHAUS	233
855	Micro Solutions Computer Products	253
*	Micrografx	67
924	Micron Electronics	NE2-NE3
*	Micron Electronics	NE26
120	Micron Electronics	24-25
119	Micron Electronics	86
164	Micron Electronics	121-126
370	Micron Electronics	127
013	Micron Electronics	151-154
*	Microsoft	C2-C4, p1
*	Microsoft	26-27
*	Microsoft	112-115
296	Midwest Memory Works	245
010	Midwest Computer Works	256-257
054	Mitsuba Corp.	229

Reader Service No.	Advertiser	Page
356	Motorola ISG	18
107	NEC Technologies	204-205
327	NECX	281
266	Netgear	329
877	NetManage, Inc.	NE21
161	Netscape	221
*	Nokia	20-21
394	Olivetti	168-169
*	Oracle Corp.	NE5
047	PC Connection	258
080	PC Power and Cooling	88
199	PC Zone	246-247
092	PCs Compleat	259
268	PCs Compleat	260-261
016	PCs Compleat	262-263
385/176	Powerquest Corp.	211
148	Primavera Systems	61
039	Princeton Graphic Systems	16-17
287	ProGen Systems	129
264	ProGen Systems	144
884	QMS	NE9
310	QMS	30
007	Rainbow Technologies	213
309	S.A.G./Storage Solutions	186-187
033	Samsung	175
871	Seagate Technologies	NE15
359	Softbank Expos	344
*	Sony Computer Peripherals	82-83
043	SPSS, Inc.	279
057	Statsoft	45
132	Sun Microsystems	5
335	Sun Microsystems	219
053	Swan Technologies	105-108
308	Symantec Corporation	100
246	Texas Instruments	98-99
379	Toshiba America	64-65
*	US Robotics Inc.	134-135
051	USA Flex	268
*	Visio	212
085	Winbook	77
163	Xerox Corporation	62
*	ZD-TV	280

*No Reader Service#. Please Call Advertiser For Information.

Advertisers' Index PRODUCTS

Reader Service No.	Company	Product	Page
ACCELERATOR BOARDS			
189	Diamond Multimedia Systems	Stealth 3D	342
*	Intel Corporation	Pentium Pro	162-163
ADD-ON BOARDS			
059	ATI Technologies	Graphics Accelerator Boards	32-33
CD-ROM			
218	Adaptec	SCSI CD-Recordable	320
834	Aus Communications, Inc.	AXIS CD-ROM Server	NE17
256	EXP Memory Products	CD-ROM	339
CHIPS/PROCESSORS			
391/138	H. Co/MicroMail	Memory, PCMCIA	267
*	Intel Corporation	Pentium Pro	162-163
*	Intel Corporation	Intel Tech Series	179-182
106	Kingston Technology	Kingston Memory	13
019	L.A. Trade	Memory	278
CO-PROCESSORS			
*	Intel Corporation	Intel Tech Series	179-182
COMMUNICATIONS SOFTWARE			
299	McAfee Associates, Inc.	VirusScan	156
877	NetManage, Inc.	Intranet Family	NE21
COMPUTERS/COMPATIBLES			
034	Acer America	AcerNote Light	90-92
336	ARLINGTON COMPUTER PRODUCTS	Peripherals	266
336	ARLINGTON COMPUTER PRODUCTS	Mail Order	266
122	AST Research	AST Computers	200-201
012	Austin Direct	Austin Direct Desktops & Notebooks	249-252
*	Bold Data	Pentium Pro Systems	165
*	Compaq Computer Corporation	Desktop	140-141
*	Compaq Computer Corporation	Desktop	70-71
387	CompuLink Research	Infinity	243
360	COMPUTER DISCOUNT WAREHOUSE	Hardware	235
318	COMPUTER DISCOUNT WAREHOUSE	Desktops	236-237
159	COMPUTER DISCOUNT WAREHOUSE	Hardware	238-239
109	COMPUTER DISCOUNT WAREHOUSE	Hardware	240-241
348	CompuTrend, Inc.	Premio Systems	195
343	Cyrus Corporation	Cyrus Systems Direct	190-191
*	Dell Computer Corporation	Dell Desktops and Notebook	C5-C8
*	Dell Computer Corporation	Dell Dimension	68
014	First Source International	Memory, Notebooks, Peripherals	269
*	Gateway 2000	Pentium PC, Notebooks, PCs, Mail Order	49
062	HARTFORD COMPUTER GROUP	Mail Order	270-271
*	Hewlett Packard	HP PCs	78-79
167	Insight Direct	Mail Order	272-273
278	Insight Direct	Mail Order	274-275
219	Insight Direct	Mail Order	276-277
045	Magix	Desktop Computers	244
164	Micron Electronics	Micron PC's	121-126
370	Micron Electronics	Micron PC's	127
119	Micron Electronics	Micron PC's	86
298	Midwest Memory Works	PCs	245
010	Midwest Computer Works	PCs	256-257
054	Mitsuba Corp	Pentium Pro Systems	229
107	NEC Technologies	NEC VERSA	204-205
327	NECX	PCs, Peripherals, Software	281
394	Olivetti	Echo	168-169
047	PC Connection	PCs, Peripherals, Software	258
199	PC Zone	Mail Order	246-247
287	ProGen Systems	Desktop Computers	281
264	ProGen Systems	Desktop Computers	281
053	Swan Technologies	Desktop Systems	105-108
379	Toshiba America	Notebook Computers	64-65
051	USA Flex	Notebooks, Desktop PC's, Peripherals, Printers	268
DEMONSTRATION SOFTWARE			
205	3M Visual Systems Division	3M Projection	23
DISK BACKUP & TAPE DRIVES			
854	Hewlett Packard-Colorado Memory Systems	HP DAT	NE10
855	Micro Solutions Computer Products	Backpack	253
DISPLAYS/MONITORS			
226	ADI Systems Inc.	Monitors	53
*	EIZO NANAO Technologies, Inc.	Monitors	72
367	Goldstar Electronics	Multimedia Monitors	28
296	Midwest Memory Works	Monitors	245
010	Midwest Computer Works	Monitors	256-257
*	Nokia	Monitors	20-21
039	Princeton Graphic Systems	Princeton Graphic Systems Monitors	16-17
*	Sony Computer Peripherals	Monitors	82-83
ELECTRONIC MAIL			
*	Lotus Development Corporation	CC Mail	38
ENTERTAINMENT SOFTWARE			
383	7th Level Inc.	Holy Grail. Quest for the Holy Grail	334
FAX SOFTWARE			
308	Symantec Corporation	WinFax Pro	100
FAX/MODEM			
293	3 Com Corporation	PC Adapter Cards	46-47
356	Motorola ISG	Modems	18

Reader Service No.	Company	Product	Page
FLOWCHARTING SOFTWARE			
*	Micrografix	Desktop Publishing	67
*	Visio	4.0	212
GRAPHICAL INTERFACE			
034	Acer America	AcerNote Light	90-92
GRAPHICS SOFTWARE			
292	Caere Corporation	OmniPage Pro	6
314	Corel Corporation	Office Professional	14-15
258	Corel Corporation	Corel Word Perfect Suite 7.0	159
044	Corel Corporation	Corel Bible Combo	325
103	Corel Corporation	Graphics Pack	331
041	Corel Corporation	CAD 3	337
322	Corel Corporation	Photo CD	340
042	Corel Corporation	Internet Combo	343
037	Corel Corporation	Web Graphics	96
*	Micrografix	Desktop Publishing	67
*	Visio	4.0	212
HARD DRIVES			
167	Insight Direct	Mail Order	272-273
278	Insight Direct	Mail Order	274-275
219	Insight Direct	Mail Order	276-277
283	MEGAHAUS	Mass Storage	233
HARDWARE			
293	3 Com Corporation	PC Adapter Cards	46-47
235	AMS	Notebooks	42
012	Austin Direct	Austin Direct Desktops & Notebooks	249-252
*	Bold Data	Pentium Pro Systems	165
208	Brother International Corp	Laser Printers	84
329	CTX International	Easy700 Notebook	74
*	Compaq Computer Corporation	Desktop	70-71
387	CompuLink Research	Infinity	243
348	CompuTrend Inc	Premio Systems	195
343	Cyrus Corporation	Cyrus Systems Direct	190-191
*	Dell Computer Corporation	Dell Dimension	68
189	Diamond Multimedia Systems	Stealth 3D	342
256	EXP Memory Products	CD-ROM	339
*	Epson America	Printers	10-11
294	Fuji Computer Media	Fuji Photographic Printer	341
114	Fujitsu PC Corporation	Notebooks	54-55
224	Fujitsu PC Corporation	Notebooks	56-57
367	Goldstar Electronics	Multimedia Monitors	28
*	Hewlett Packard	HP PCs	78-79
*	IBM Corporation	Token Ring	NE7
167	Insight Direct	Mail Order	272-273
278	Insight Direct	Mail Order	274-275
219	Insight Direct	Mail Order	276-277
*	Intel Corporation	Pentium Pro	162-163
*	Intel Corporation	Intel Tech Series	179-182
106	Kingston Technology	Kingston Memory	13
869	Kyocera Electronics, Inc.	Cartridge Free Printers	NE22
165	Magitronic	Notebooks	255
045	Magix	Desktop Computers	244
283	MEGAHAUS	Mass Storage	233
054	Mitsuba Corp	Pentium Pro Systems	229
327	NECX	PCs, Peripherals, Software	281
266	Netgear	Ethernet Hub	329
080	PC Power and Cooling	Power Protection/Cooling Devices	88
199	PC Zone	Mail Order	246-247
884	QMS	2425	NE9
310	QMS	Magicolor WZ	30
033	Samsung	Samsung Notebooks	175
HUBS			
266	Netgear	Ethernet Hub	329
INTERNET			
*	AT&T	AT&T WorldNet	223-225
*	Apple Computer	Internet Server	130-131
*	Apple Computer	Internet Server	133
864	Attachmate IPG	Attachmate Intranetworking	NE16
166	Intercon Corp	TCP/IP	216
006	Luckman Interactive	Web Commander	220
*	Microsoft	Internet Explorer	26-27
*	Microsoft	NT Workstation	114-115
161	Netscape	Netscape Server	221
335	Sun Microsystems	Solstice Intranet Safety	219
132	Sun Microsystems	Scalability	5
LABEL/FORM SOFTWARE			
292	Caere Corporation	OmniPage Pro	6
LAPTOP/PORTABLE COMPUTERS			
235	AMS	Notebooks	42
122	AST Research	AST Computers	200-201
012	Austin Direct	Austin Direct Desktops & Notebooks	249-252
360	COMPUTER DISCOUNT WAREHOUSE	Laptops	235
318	COMPUTER DISCOUNT WAREHOUSE	Desktops	236-237
159	COMPUTER DISCOUNT WAREHOUSE	Laptops	238-239
109	COMPUTER DISCOUNT WAREHOUSE	Laptops	240-241
329	CTX International	Easy700 Notebook	74
*	Dell Computer Corporation	Dell Desktops and Notebook	C5-C8
014	First Source International	Memory, Notebooks, Peripherals	269
114	Fujitsu PC Corporation	Notebooks	54-55
224	Fujitsu PC Corporation	Notebooks	56-57
*	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals, Pentium PC	48A-49
062	HARTFORD COMPUTER GROUP	Mail Order	270-271
165	Magitronic	Notebooks	255

Advertisers' Index PRODUCTS

Reader Service

No.	Company	Product	Page
013	Micron Electronics	Micron Notebooks	151-154
296	Midwest Memory Works	PCs Hardware	245
010	Midwest Computer Works	PCs Hardware	256-257
107	NEC Technologies	NEC VERSA	204-205
394	Olivetti	Echo	168-169
199	PC Zone	Mail Order	246-247
092	PCs Complete	PCs, Notebooks, Software	259
268	PCs Complete	PCs, Notebooks, Software	260-261
016	PCs Complete	PCs, Notebooks, Software	262-263
033	Samsung	Samsung Notebooks	175
246	Texas Instruments	TI Notebooks	98-99
379	Toshiba America	Notebook Computers	64-65
051	USA Flex	Notebooks, Desktop PC's, Peripherals, Printers	268
085	Winbook	Winbook FX	77

LOCAL AREA NETWORKING

293	3 Com Corporation	PC Adapter Cards	46-47
864	Attachmate IPG	Attachmate Intranetworking	NE16
934	Aus Communications, Inc.	AXIS CD ROM Server	NE17
360	COMPUTER DISCOUNT WAREHOUSE	Networking Products	235
318	COMPUTER DISCOUNT WAREHOUSE	Desktops	236-237
159	COMPUTER DISCOUNT WAREHOUSE	Networking Products	238-239
109	COMPUTER DISCOUNT WAREHOUSE	Networking Products	240-241
062	HARTFORD COMPUTER GROUP	Mail Order	270-271
266	Netgear	Ethernet Hub	329
161	Netscape	Netscape Server	221
310	QMS	Magicolor WZ	30

MAIL ORDER

336	ARLINGTON COMPUTER PRODUCTS	Mail Order	266
336	ARLINGTON COMPUTER PRODUCTS	Peripherals	266
*	Compaq Computer Corporation	Desktop	140-141
387	CompuLink Research	Infinity	243
360	COMPUTER DISCOUNT WAREHOUSE	Reseller	235
318	COMPUTER DISCOUNT WAREHOUSE	Desktop	236-237
159	COMPUTER DISCOUNT WAREHOUSE	Reseller	238-239
109	COMPUTER DISCOUNT WAREHOUSE	Reseller	240-241
014	First Source International	Memory, Notebooks, Peripherals	269
*	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals, Pentium PC	48A-49
391/138	H Co./MicroMail	Memory, PCMCIA, Fax/Modem, LAN	267
019	L.A. Trade	Memory	278
045	Magix	Desktop Computers	244
283	MEGAHAUS	Mass Storage	233
120	Micron Electronics	Client Pro	24-25
296	Midwest Memory Works	Mail Order	245
010	Midwest Computer Works	Mail Order	256-257
327	NECX	PCs, Peripherals, Software	281
047	PC Connection	PCs, Peripherals, Software	258
199	PC Zone	Mail Order	246-247
092	PCs Complete	PCs, Notebooks, Software	259
268	PCs Complete	PCs, Notebooks, Software	260-261
016	PCs Complete	PCs, Notebooks, Software	262-263
053	Swan Technologies	Desktop Systems	105-108
051	USA Flex	Notebooks, Desktop PC's, Peripherals, Printers	268

MAPPING SOFTWARE

240	ESRI	ArcView GIS 3.0*	210
-----	------	------------------	-----

MASS STORAGE

934	Axis Communications, Inc.	AXIS CD ROM Server	NE17
854	Hewlett Packard-Colorado Memory Systems	HP DAT	NE10
073	Hewlett Packard-Colorado Memory Systems	Mass Storage	35
283	MEGAHAUS	Mass Storage	233
855	Micro Solutions Computer Products	Backpack	253
309	S.A.G./Storage Solutions	Servers and Storage	186-187
871	Seagate Technologies	Tape Drives	NE15

MEMORY

014	First Source International	Memory, Notebooks, Peripherals	269
391/138	H Co./MicroMail	Memory	267
106	Kingston Technology	Kingston Memory	13
859	Kingston Technology	Memory	NE23
019	L.A. Trade	Memory	278

MISCELLANEOUS

*	ZD-TV	MSNBC	280
---	-------	-------	-----

MODEMS

293	3 Com Corporation	PC Adapter Cards	46-47
926	Hayes Microcomputer Products	Modems	NE25
*	US Robotics Inc.	ISDN Sportster	134-135

MULTIMEDIA

059	ATI Technologies	Graphics Accelerator Boards	32-33
189	Diamond Multimedia Systems	Stealth 3D	342
256	EXP Memory Products	CD-ROM	339
367	Goldstar Electronics	Multimedia Monitors	28
062	HARTFORD COMPUTER GROUP	Mail Order	270-271
855	Micro Solutions Computer Products	Backpack	253
*	Nokia	Monitors	20-21
*	Sony Computer Peripherals	Monitors	82-83

MULTIMEDIA SOFTWARE

314	Corel Corporation	Office Professional	14-15
258	Corel Corporation	Corel Word Perfect Suite 7.0	159
044	Corel Corporation	Corel Bible Combo	325
103	Corel Corporation	Graphics Pack	331
041	Corel Corporation	CAD 3	337
322	Corel Corporation	Photo CD	340
042	Corel Corporation	Internet Combo	343
037	Corel Corporation	Web Graphics	96

Reader Service

No.	Company	Product	Page
*	Micrograph	Desktop Publishing	67

NETWORKING SOFTWARE

858	Artisoft Inc.	CoSession	NE18
864	Attachmate IPG	Attachmate Intranetworking	NE16
*	IBM Corporation	Enterprise Communications/PCOM	NE
161	Netscape	Netscape Server	221
*	Oracle Corp.	Enterprise 2000	NE5

OCR PRODUCTS

163	Xerox Corporation	Xerox Textbridge	62
-----	-------------------	------------------	----

ON LINE DATABASE/SERVICES

*	AT&T	AT&T WorldNet	223-225
---	------	---------------	---------

ORGANIZATIONAL SOFTWARE

385/176	Powerquest Corp.	PartitionMagic	211
*	Visio	4.0	212

OS/2 SOFTWARE

*	IBM Corporation	IBM Open Windows	173
---	-----------------	------------------	-----

PC ACCESSORIES

356	Motorola ISG	Modems	18
-----	--------------	--------	----

PC DIRECT

336	ARLINGTON COMPUTER PRODUCTS	Mail Order	266
012	Austin Direct	Austin Direct Desktops & Notebooks	249-252
387	CompuLink Research	Infinity	243
360	COMPUTER DISCOUNT WAREHOUSE	Reseller	235
318	COMPUTER DISCOUNT WAREHOUSE	Desktop	236-237
159	COMPUTER DISCOUNT WAREHOUSE	Reseller	238-239
109	COMPUTER DISCOUNT WAREHOUSE	Reseller	240-241
014	First Source International	Memory, Notebooks, Peripherals	269
391/138	H Co./MicroMail	Memory, PCMCIA, Hard Drives	267
062	HARTFORD COMPUTER GROUP	Mail Order	270-271
167	Insight Direct	Mail Order	272-273
278	Insight Direct	Mail Order	274-275
219	Insight Direct	Mail Order	276-277
019	L.A. Trade	Memory	278
165	Magitronic	Notebooks	255
045	Magix	Desktop Computers	244
283	MEGAHAUS	Mass Storage	233
855	Micro Solutions Computer Products	Backpack	253
296	Midwest Memory Works	Reseller	245
010	Midwest Computer Works	Reseller	256-257
327	NECX	PCs, Peripherals, Software	281
047	PC Connection	PCs, Peripherals, Software	258
199	PC Zone	Mail Order	246-247
092	PCs Complete	PCs, Notebooks, Software	259
268	PCs Complete	PCs, Notebooks, Software	260-261
016	PCs Complete	PCs, Notebooks, Software	262-263
043	SPSS, Inc.	Statistical & Windows Software	279
051	USA Flex	Notebooks, Desktop PC's, Peripherals, Printers	268

PCMCIA

218	Adaptec	SCSI CD-Recordable	320
391/138	H Co./MicroMail	Fax/Modem, Flash, SRAM, Drives	267
*	US Robotics Inc.	ISDN Sportster	134-135

PERIPHERALS

293	3 Com Corporation	PC Adapter Cards	46-47
208	Brother International Corp.	Laser Printers	84
189	Diamond Multimedia Systems	Stealth 3D	342
*	Epson America	Printers	10-11
014	First Source International	Memory, Notebooks, Peripherals	269
294	Fuji Computer Media	Fuji Photographic Printer	341
*	Gateway 2000	Notebooks, PCs, Mail Order, Peripherals	48A-49
367	Goldstar Electronics	Multimedia Monitors	28
*	Hewlett Packard	JetDirect	50
869	Kyocera Electronics, Inc.	Cartridge Free Printers	NE22
356	Motorola ISG	Modems	18
*	Nokia	Monitors	20-21
394	Olivetti	Echo	168-169
047	PC Connection	PCs, Peripherals, Software	258
199	PC Zone	Mail Order	246-247
884	QMS	2425	NE9
310	QMS	Magicolor WZ	30
053	Swan Technologies	Desktop Systems	105-108

POWER PROTECTION

887	American Power Conversion	Back UPS Pro	NE27
162	American Power Conversion	Back-UPS Office	327
080	PC Power and Cooling	Power Protection/Cooling Devices	88

PRESENTATION SOFTWARE

205	3M Visual Systems Division	3M Projection	23
-----	----------------------------	---------------	----

PRINTER ACCESSORIES

*	Hewlett Packard	JetDirect	50
310	QMS	Magicolor WZ	30

PRINTERS

208	Brother International Corp.	Laser Printers	84
*	Canon Computer Systems	Canon Multifunction Printer	2-3
*	Epson America	Printers	10-11
294	Fuji Computer Media	Fuji Photographic Printer	341
*	Hewlett Packard	JetDirect	50
869	Kyocera Electronics, Inc.	Cartridge Free Printers	NE22
884	QMS	2425	NE9

Advertisers' Index PRODUCTS

Reader Service

No.	Company	Product	Page
310	QMS	Magicolor WZ	30
051	USA Flex	Notebooks, Desktop PC's, Peripherals, Printers	268

PROGRAMMERS TOOLS UTILITIES

385/176	Powerquest Corp	PartitionMagic	211
007	Rainbow Technologies	Program Developers	213

REMOTE COMPUTING

299	McAfee Associates, Inc.	VirusScan	156
*	US Robotics Inc	ISDN Sportster	134-135

SCANNERS

*	Epson America	Scanner	59
---	---------------	---------	----

SECURITY

007	Rainbow Technologies	Program Developers	213
-----	----------------------	--------------------	-----

SERVERS

*	Apple Computer	Internet Server	130-131
*	Apple Computer	Internet Server	133
012	Austin Direct	Austin Direct Desktops & Notebooks	249-252
*	Hewlett Packard	NetServers	161
*	IBM Corporation	IBM Server	81
924	Micron Electronics	Micron Servers	NE2-NE3
120	Micron Electronics	Client Pro	24-25
*	Microsoft	NT Servers	112-113
161	Netscape	Netscape Server	221
309	S.A.G./Storage Solutions	Servers and Storage	186-187

SOFTWARE

383	7th Level Inc.	Holy Grail: Quest for the Holy Grail	334
858	Artisoft Inc.	CoSession	NE18
864	Attachmate IPG	Attachmate Intranetworking	NE16
369	Connectix	Agent 95	215
240	ESRI	ArcView GIS 3.0	210
*	IBM Corporation	IBM Open Windows	173
167	Insight Direct	Mail Order	272-273
278	Insight Direct	Mail Order	274-275
219	Insight Direct	Mail Order	276-277
006	Luckman Interactive	Web Commander	220
299	McAfee Associates, Inc.	VirusScan	156
*	Microsoft	Presentation Software	C2-C4, p1
*	Microsoft	Internet Explorer	26-27
877	NetManage, Inc.	Intranet Family	NE21
161	Netscape	Netscape Server	221
047	PC Connection	PCs, Peripherals, Software	258
092	PCs Complete	PCs, Notebooks, Software	259
268	PCs Complete	PCs Notebooks, Software	260-261
016	PCs Complete	PCs Notebooks, Software	262-263
385/176	Powerquest Corp	PartitionMagic	211
148	Primavera Systems	Project Management	61
043	SPSS, Inc.	Statistical & Windows Software	279
335	Sun Microsystems	Solstice Intranet Safety	219
132	Sun Microsystems	Scalability	5
308	Symantec Corporation	WinFax Pro	100
*	Visio	4.0	212
163	Xerox Corporation	Xerox Textbridge	62

SPREADSHEET/TEMPLATES

*	Microsoft	Presentation Software	C2-C4, p1
---	-----------	-----------------------	-----------

STATISTICAL SOFTWARE

043	SPSS, Inc.	Statistical & Windows Software	279
057	Statsoft	Statistical Software	45

TCP/IP

877	NetManage, Inc.	Intranet Family	NE21
-----	-----------------	-----------------	------

TOKEN RING ADAPTERS

*	IBM Corporation	Token Ring	NE7
---	-----------------	------------	-----

UTILITIES

369	Connectix	Agent 95	215
006	Luckman Interactive	Web Commander	220
299	McAfee Associates, Inc.	VirusScan	156

VIDEO GRAPHICS/BOARDS

189	Diamond Multimedia Systems	Stealth 3D	342
-----	----------------------------	------------	-----

WINDOWS SOFTWARE

369	Connectix	Agent 95	215
*	IBM Corporation	IBM Open Windows	173
895	Insignia Solutions	NTRIGUE	NE29
299	McAfee Associates, Inc.	VirusScan	156
*	Micrographix	Desktop Publishing	67
*	Microsoft	Presentation Software	C2-C4, p1
877	NetManage, Inc.	Intranet Family	NE21
385/176	Powerquest Corp	PartitionMagic	211
148	Primavera Systems	Project Management	61
043	SPSS, Inc.	Statistical & Windows Software	279
057	Statsoft	Statistical Software	45
308	Symantec Corporation	WinFax Pro	100
*	Visio	4.0	212
163	Xerox Corporation	Xerox Textbridge	62

WORKSTATIONS

*	Bold Data	Pentium Pro Systems	165
*	Hewlett Packard	HP PCs	78-79
054	Mitsuba Corp.	Pentium Pro Systems	229
*	Microsoft	NT Workstation	114-115

For Additional Categories see MARKETPLACE PRODUCT INDEX Page 282



Coming Up

Collaboration on the Internet

Whether you want to make free long-distance calls from your computer or build a communications system for thousands of employees, the Internet can provide a solution. Our three-part cover story is a guided tour of dozens of innovative products that turn the Internet into the ultimate communications tool.

Real-Time Communication

Internet voice, video, and collaboration technologies connect you to the rest of the world in real time. Internet phones let you talk long-distance via your PC. Internet-enabled video offers a lower-cost alternative to traditional videoconferencing solutions. On the leading edge, Internet-enabled collaboration products let you talk to coworkers, share applications, or exchange files. We test 17 products from leading vendors including IBM, Intel, Microsoft, Netscape, Quarterdeck, and VocalTec.

Newsgroups and E-Mail Front Ends

So you think the Internet is just for browsing information, downloading tools, and buying merchandise? Think again, because there's an entire subculture built around Internet newsgroups and e-mail. Newsgroups enable you to participate in threaded discussions on a whole host of topics; Internet e-mail lets you send a mail message to anyone in the world, as long as you know where they're @. We review close to two dozen such products so you can determine what best fits your Internet needs.

Groupware: Reaching for the Net

It's been a busy year in the groupware trenches—Microsoft's long-awaited Exchange Server 4.0 finally shipped; Netscape's Internet-based SuiteSpot became a real threat; and Lotus shipped the next generation of its leading groupware system, Notes, Release 4. In this roundup we look at these three contenders and analyze their blends of e-mail, collaboration services, Internet integration, and application development. We also cover the next version of Novell's GroupWise, report on changes to traditional LAN-based e-mail systems like Lotus cc:Mail, and provide a comprehensive overview of the growth of Internet messaging standards and what they mean for your business.

17-Inch Monitors

One great obstacle to efficient productivity is being limited to only a small screenful at a time. But as 17-inch monitors continue to drop in price, the upgrade from pinhole to panorama is within reach. With these displays, you gain a much larger view of your images, spreadsheets, and Web pages. Some even come with built-in speakers. We put 49 monitors through a rigorous battery of tests to help you choose the best display for your needs.

Editorial Product Index

Reader Service

No.	Product	Company	Page
441	Aberdeen Dual Pro 200	Aberdeen Inc.	158
434	AcerNote Nouvo	Acer America Corp.	39
442	AcerPower Pentium Pro	Acer America Corp.	158
443	ACMA zPower Pro 200	ACMA Computers Inc.	160
444	ACW P6-200DS	ACW (All Computer Warehouse)	160
445	ALR Evolution Dual6/200	Advanced Logic Research Inc.	160
951	AltaVista Mail 1.0	Digital Equipment Corp.	NE19
446	American Multisystems InfoGold PP200C	American MultiSystems Inc.	164
447	AST Bravo MS-T 6200	AST Computer	164
423	AutoCAD LT for Windows 95 and Windows NT	Autodesk Inc.	76
422	AVerKey 5	AVerMedia Inc.	75
426	backpack pd/cd	Micro Solutions Inc.	76
415	Broadway	Data Translation Inc.	51
448	Brysis BDI PP-200NT System	Brysis Data Inc.	172
449	Caliber Voyager Pro	Caliber Computer Corp.	172
954	CD NetRecord for NetWare, Version 1.0	Meridian Data Inc.	NE8
475	Cobra XLP Pro 200	Robotech Inc.	199
403	Color QuickCam	Connectix Corp.	60
406	ColorWorks 2.0	SPG Inc.	63
431	Compaq Presario 4000 series	Compaq Computer Corp.	80
431	Compaq Presario 8000 series	Compaq Computer Corp.	80
420	CompuServe 3.0 for Windows 95 and NT	CompuServe Inc.	75
450	Comtrade Wide SCSI Powerstation	Comtrade Electronic Inc.	174
410	CorelCAD	Corel Corp.	76
410	Corel Presentations 7	Corel Corp.	69
411	CrystaLake Model 140, CrystaLake Model 650	CrystaLake Multimedia Inc.	69
419	Crystalizer TidalWave32 PnP	Crystal Computer Corp.	75
451	CyberMax ProMax 200	CyberMax Computer Inc.	174
452	Dell Dimension XPS Pro200n	Dell Computer Corp.	176
452	Dell OptiPlex GXPro 200	Dell Computer Corp.	176
453	Diamond DT Advance Pro-200	Diamond Technologies Inc.	176
435	Digital HiNote Ultra II	Digital Equipment Corp.	39
454	DirectWave Blue Thunder PN200S	DirectWave Inc.	177
955	DiscPort Tower	Microtest Inc.	NE8
421	Dow Jones Business Information Services	Dow Jones & Co. Inc.	75
455	DTK Apri-31M/200	DTK Computer Inc.	177
412	Dynamite 128	Hercules Graphics	66
456	EPS Evolution XL-Pro200	EPS Technologies Inc.	177
457	Everex STEP DPi/Pro	Everex Systems Inc.	178
427	EZFlyer 230	SyQuest Technology Inc.	76
458	FCS Pentium Pro-200 System	First Computer Systems Inc.	178
407	Freemark Mail	Freemark Communications Inc.	44
459	Gateway G6-200	Gateway 2000 Inc.	183
414	GrafixStar 600	VideoLogic Inc.	66
460	Hertz Z-Pro200	Hertz Computer Corp.	183
461	Hewlett Rand PP200 Mission Critical	Hewlett Rand Corp.	183
463	HiQuality Venus Station	HiQuality Computer Systems	185
408	HoTMail	HoTMail	44
462	HP Vectra VA 6/200 MT	Hewlett-Packard Co.	184
952	IMail Server for Windows NT, Version 2.61	Ipswitch Inc.	NE20

409	Juno	Juno Online Services LP	44
418	Kodak Digital Science Snapshot Photo Scanner	Eastman Kodak Co.	75
413	LightSpeed 128	STB Systems	66
953	LogiCRAFT LanCD/XF 5500	LogiCRAFT Information Systems	NE6
464	Maximus Magna Artist Pro	Maximus Computers Inc.	188
465	Mega Double Impact Pentium Pro 200	Mega Computer Systems	189
954	Meridian CD Net 807	Meridian Data Inc.	NE8
466	MicroFlex-PCI/Pro200	Micro Express	192
428	MicroHelp Zip	MicroHelp Inc.	80
436	Micron Millennia Transport	Micron Electronics Inc.	39
	Microsoft Windows NT 4.0	Microsoft Corp.	101
467	Millennia Plus Pro200	Micron Electronics Inc.	193
424	MiniCad 6 for Windows	Diehl Graphsoft Inc.	76
468	Mitsuba Premier-Pro 200	Mitsuba Corp.	194
405	Multimedia MM100	Scala USA Inc.	63
469	Multiwave Pro Power	Multiwave Technology Inc.	194
470	NEC PowerMate Pro 2200	NEC Technologies Inc.	194
957	Network RomMaker, Version 3.20	JVC Information Products of America	NE8
401	OmniPage Pro for Windows 95, Version 7.0	Caere Corp.	43
425	Opti-UPS 280E, 420E, 650E, 1000E, 1400E	ViewSonic Corp.	76
	OS/2 Warp 4.0	IBM Corp.	101
429	pcAnywhere32 for Windows 95 and Windows NT	Symantec Corp.	80
430	PhotoImpact GIF/JPEG SmartSaver	Ulead Systems Inc.	80
956	PlexServer NT	Plextor Corp.	NE11
471	Polywell Poly P6-200N	Polywell Computers Inc.	197
472	ProGen Nova II 200MHz	ProGen Systems	198
473	Quantex QP6/200 WS-2	Quantex Microsystems	198
416	REALmagic Ultra	Sigma Dimensions Inc.	51
474	Reason Square 6 NA / VA	Reason Technology Inc.	198
476	SAG STA Pro 200 Desktop	SAG Electronics	199
432	Sharp PC-9080	Sharp Electronics Corp.	75
433	SnagIt Twin Pack	TechSmith Corp.	52
417	Submit THIS! 1.0	Microrim Inc.	58
477	Sys Performance Pro 200	Sys Technology Inc.	202
478	Tagram Thunderbolt Corporate T6	Tagram System Corp.	202
402	TextBridge Pro 96	Xerox Desktop Document Systems	43
479	Total Peripherals Lightning	Total Peripherals Inc.	202
480	Unisys Aquanta DM/6	Unisys PC Division	204
481	Unitek UT-PP200 Commando	Unitek Technology Inc.	204
482	Vektron Optima Pro Station	Vektron	204
404	WinCam One	StarDot Technologies	60
483	Xi Pro200 MTower DP/SP	Xi Computer Corp.	205
484	Zenon Optima Pro Station	Zenon Technology Inc.	205

NE—Network Edition.

For information about the Network Edition of *PC Magazine*, call Circulation at 800-289-0429.

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Block That Metaphor!

"Economic pressures will likely push middleware further down the information-pipeline chain until it falls off the back end, unnoticed and unmourned by most."—*BYTE*

Sematech president William Spencer smiles for the camera and destroys the clean room at the same time. (*Scientific American*.)



Keep Blowing! Keep Blowing!

"DRAM is not static, meaning it periodically needs to be 'refreshed' by having air shot on it. SRAM is static, so it's more expensive and it's faster, but it doesn't need air to keep it going. Both of these ... are often used in computers."—*THE IDAHO STATESMAN*



RICHARD TENNANT

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802 or via e-mail (text items only) to don_willmott@zd.com. Winners this issue: W. G. Dickson, Nanci Little, Craig Osterhus, David Riley, and Daniel Yuen.



At last! We've finally found the Internet's opening screen! (*Office Furniture Center catalog*.)

And for Quicker Word Processing, Type Faster

Fifth Generation Systems' Fastback was once a leading backup program. It no longer exists, but we couldn't resist sharing this classic bit of documentation:

"Disks can be changed easily in 4 seconds or less by using both hands. The technique:

1. Hold a diskette in one hand.
2. Wait for the prompt.
3. Use free hand to remove diskette.
4. Insert diskette."

Due to a manufacturer's delay in shipping, the Toshiba color notebook computer (no. 424-101) advertised on page 6 of the Sunday, February 18 insert for \$1599 will not be available in some Office Depot stores on this date. We do expect delivery of this computer shortly and apologize for any inconvenience this might have caused you, or valued customers.

And if you don't like it you can lump it. (*Office Depot ad*.)



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Dell's featured computer artist is Diane Fenster of Pacifica, CA.

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